Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

CSAS | SCCS

Canadian Science Advisory Secretariat | Secrétariat canadien de consultation scientifique

Research Document 2009/076 | Document de recherche 2009/076

Information on Atlantic salmon (*Salmo salar*) from Salmon Fishing Area 18 (Gulf Nova Scotia) of relevance to the development of a COSEWIC status report

Renseignements sur le Saumon atlantique (*Salmo salar*) de la zone de pêche du saumon 18 (golfe de la Nouvelle-Écosse) utiles pour la préparation du rapport de situation du COSEPAC

C. Breau, G. Chaput, P.H. LeBlanc[1], and P. Mallet

P.O. Box / C.P. 5030
Moncton, NB
E1C 9B6

[1] P.O. Box / C.P. 1006
Dartmouth, NS
B2Y 4A2

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

La présente série documente les fondements scientifiques des évaluations des ressources et des écosystèmes aquatiques du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Research documents are produced in the official language in which they are provided to the Secretariat.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au Secrétariat.

This document is available on the Internet at: | Ce document est disponible sur l'Internet à:
http://www.dfo-mpo.gc.ca/csas/

ISSN 1499-3848 (Printed / Imprimé)
ISSN 1919-5044 (Online / En ligne)
© Her Majesty the Queen in Right of Canada, 2009
© Sa Majesté la Reine du Chef du Canada, 2009
Canada

Correct citation for this publication:

Breau, C., G. Chaput, P.H. LeBlanc, and P. Mallet. 2009. Information on Atlantic salmon (*Salmo salar*) from Salmon Fishing Area 18 (Gulf Nova Scotia) of relevance to the development of the COSEWIC status report. DFO Can. Sci. Adv. Secr. Res. Doc. 2009/076. iv + 53p.

ABSTRACT

This document summarizes the stock status of Atlantic salmon for rivers in Salmon Fishing Area 18 (SFA 18; Northumberland Strait Nova Scotia and Western Cape Breton) of relevance to the development of the status report by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The assessment of stock status is based on abundance of adults, juveniles and smolts in selected rivers. Atlantic salmon presence can be documented in 43 of 55 rivers in SFA 18. Since 1985, salmon returns to the Margaree River, an index river in SFA 18, have exceeded conservation requirements every year. Salmon return estimates for all of SFA 18 indicate that both small salmon (< 63 cm fork length) and large salmon (>= 63 cm fork length) were more abundant during the past three generations (1994 to 2008) than in earlier years (1970 to 1993). In SFA 18, a conservation requirement of less than 100 large salmon (less than 500,000 eggs) is needed in 50% of the rivers for which this reference has been quantified. Juvenile densities in monitored rivers remained at high levels, which suggest attainment of spawning requirements. Since 1999, estimates indicate that 33 to 47 smolts were produced per large salmon return in the Margaree River. Under the current fisheries management plan, exploitation of salmon from these rivers is not considered excessive and limiting abundance of salmon.

RÉSUMÉ

Le présent document résume l'état des stocks de saumon atlantique dans les rivières de la zone de pêche du saumon 18 (ZPS 18), qui comprend la partie néo-écossaise du détroit de Northumberland et la partie ouest de l'île du Cap-Breton, en vue de la préparation du rapport de situation par le Comité sur la situation des espèces en péril au Canada (COSEPAC). L'évaluation de l'état des stocks repose sur l'abondance de poissons adultes et juvéniles ainsi que de saumoneaux dans les rivières sélectionnées. La présence du saumon atlantique est attestée dans 43 des 55 rivières de la ZPS 18. Depuis 1985, les retours du saumon atlantique dans la rivière Margaree, une rivière repère de cette zone de pêche, ont dépassé les impératifs annuels de conservation. Les estimations des retours pour toute la ZPS 18 révèlent que tant les petits saumons (longueur à la fourche < 63 cm) que les grands saumons (longueur à la fourche >= 63 cm) ont été plus nombreux au cours des trois dernières générations (1994 à 2008) que dans les années précédentes (1970 à 1993). Les impératifs de conservation dans la ZPS 18 sont de moins de 500 000 œufs, ce qui correspond à la présence de moins de 100 grands saumons, dans 50 % des rivières pour lesquelles cette information a été quantifiée. La densité des poissons juvéniles dans les rivières étudiées demeure à des niveaux élevés, ce qui suggère que les besoins en matière de frai sont atteints. Les estimations indiquent que depuis 1999, le retour d'un grand saumon dans la rivière Margaree se traduit par la présence de 33 à 47 saumoneaux. Par conséquent, dans le cadre du plan actuel de gestion de la pêche, on considère que l'exploitation des saumons dans ces rivières n'est pas excessive et qu'elle ne limite pas leur abondance.

INTRODUCTION

The Atlantic salmon, *Salmo salar*, is an anadromous (utilizes both freshwater and saltwater environments) species. In their first year, juvenile Atlantic salmon are named young-of-the-year or fry and older juveniles are named parr. Juveniles spend between two to eight years in fresh water after which they undergo physiological change for ocean migration (termed smolts) (O'Connell et al. 2006). Adults return to freshwater during May to November and spawning occurs from October to December. Spawning adults consist of small salmon (fork length < 63cm) and large salmon (fork length >= 63cm) with varying proportions of small and large salmon based on the area and the river. Small salmon are mostly maiden fish that have never spawned and have spent one year at sea (1SW) before returning to spawn for the first time. The large salmon component consists of maiden fish that return after 2 years (2SW) or more (e.g. 3SW) at sea and fish that have already spawned (repeat spawners); collectively large salmon are also referred to as multi-sea-winter salmon (MSW).

In the Maritime Provinces of eastern Canada, there are nine Salmon Fishing Areas (SFA) with river-specific harvesting regulations (Fig. 1). Rivers that flow into the Northumberland Strait of Nova Scotia and Western Cape Breton Island form SFA 18 (Fig. 2). In SFA 18, Atlantic salmon are known to inhabit 55 rivers of which the Margaree River is the largest river system (drainage area: 1,100 km^2) (Table 1). Eleven of 28 rivers in SFA 18 with quantified fluvial habitat area have less than 0.1 million m^2 of juvenile rearing area (Table 1).

Atlantic salmon from rivers in SFA 18 undertake long oceanic migrations as shown by recoveries of tagged salmon at West Greenland and in Newfoundland and Labrador. Tagged smolts from rivers in SFA 18 were recaptured as salmon at West Greenland and tagged bright salmon from the Margaree River have been recaptured along the Strait of Belle Isle, northeast coast of Newfoundland and at West Greenland (Chaput et al. 1993).

The reference point for conservation is the egg deposition rate of 2.4 eggs per m^2 of wetted rearing area for juvenile production. Fifty percent of the 28 rivers in SFA 18 with defined conservation requirements have a conservation requirement of less than 500,000 eggs, corresponding to less than 100 large salmon (Table 1; O'Connell et al. 1997). For the Margaree River, 582 small salmon and 1,036 large salmon are required to meet conservation (Claytor et al. 1987). The last stock assessment was published for 2002 and included information from seven rivers on mainland Nova Scotia and one river in Cape Breton (DFO 2003).

In 1984, the commercial salmon fishery was closed in the Maritime Provinces and the mandatory hook and release of large salmon in the recreational fishery was introduced. Two user groups have access to Atlantic salmon since 1984: Aboriginal peoples and recreational fisheries. Aboriginal peoples have first access, after conservation, based on communal needs, social and ceremonial purposes.

The present document provides information on Atlantic salmon from SFA 18. It provides updated information on biological characteristics of Atlantic salmon stocks, abundance, population trends and spatial distribution in selected rivers of SFA 18.

LIFE HISTORY AND POPULATION CHARACTERISTICS

The most complete information on biological characteristics is available for the Margaree River (LeBlanc et al. 2005). Information on characteristics from other rivers is summarized in Chaput et al. (2006b) and O'Connell et al. (2006).

Atlantic salmon returns to SFA 18 rivers are characterized by a higher proportion of large salmon relative to small salmon (Chaput et al. 2006b). In the Margaree River, the relative abundance of small salmon, based on trapnet data collected during 1987 to 1996, is estimated to be less than 40% of the total salmon return (Table 2; LeBlanc et al. 2005). Males make up 84% of small salmon (fork length < 63cm) in the Margaree River (Table 3), a slightly lower proportion compared to SFA 18 overall (based on selected rivers) with over 90% of small salmon being males (Chaput et al. 2006b).

Maiden fish, first time spawners, is the most abundant group in the Margaree River with 2SW salmon averaging 59% of the fish returns (Table 2). Small salmon are comprised of more than 95% maiden fish. Maiden 2SW and 3SW salmon (fork length >= 63cm) are more than 70% female (Table 3). The mean fork length of maiden fish is 55.3 cm for 1SW, 75.5 cm for 2SW and 89.0 cm for 3SW fish (Table 4).

A proportion of the population return to spawn more than once and these fish are known as repeat-spawners. Repeat-spawners consist of alternate spawners, fish that spend an entire year at sea between spawning events, and consecutive spawners, fish that spawn over two consecutive years. In Margaree River, an average of 8% of the salmon returns were repeat-spawners (Table 2) and 2SW alternate spawners are the more common life history trait among MSW fish (Table 5). Females comprise less than 30% of the repeat-spawners of 1SW maiden age whereas more than 85% of 2SW and 3SW alternate and consecutive spawners consist of females (Table 5). Mean fork length varies between 66.2 cm to 84.4 cm for consecutive spawners and 81.1 to 92.3 cm for alternate spawners (Table 6).

Water discharge plays an important role in run-timing of salmon. In most rivers of SFA 18, Atlantic salmon ascend rivers in the fall, September onward (Claytor 1996). However, Chéticamp River has an important early run of salmon although salmon also enter in the fall (Chaput et al. 2006b; Landry et al. 2005; Claytor 1996). River Philip historically was reported to have an early run but in recent years, salmon enter freshwater only in the fall although observations of salmon in the river in July have been noted during wet summers. The Margaree River has an important early run of fish but a larger number of fish return in the fall (Claytor 1996).

INFORMATION RELEVANT TO THE DISCUSSION ON DU'S

Historically, enhancement activities have taken place in rivers of SFA 18 as a means to supplement fish numbers and to augment the early run (before August 31) component of the stock (Table 7). In particular, there was an interest in enhancing the early run component of the salmon ascending the Margaree River and therefore; early run fish from other rivers were stocked in the system (Marshall 1982). Prior to 1998, many rivers in the Gulf Region were stocked with early juvenile stages of salmon as part of DFO enhancement programs (Chaput et al. 2006b). Since 1986, stocking of hatchery-reared salmon has only occurred in the Margaree River using early run fish from the Margaree River as broodstock. Returns of clipped large

salmon (hatchery origin) never exceeded 10% and in the early 1990s, their contribution to egg deposition averaged 5% (Marshall et al. 1997).

INFORMATION SOURCES SOUGHT/CONSIDERED

There is a large amount of diverse data on the Atlantic salmon from SFA 18. Assessments were conducted annually for the Margaree River between 1986 and 2003 and intermittently since. Other rivers assessed in different periods include the Chéticamp River (Landry et al. 2005; Chaput et al. 2006a) and several rivers (River Philip, East R. (Pictou), Sutherlands River) of mainland Gulf Nova Scotia (O'Neil et al. 2000). Juvenile electrofishing surveys have been conducted in several rivers in SFA 18, some dating to the early 1970s (Cameron and Gray 1979; Chaput and Claytor 1989; LeBlanc et al. 2005). The most extensive abundance indicator is angling data from licence stub returns from 1984 to the present. Angling catches from the Margaree River are available since 1947 (Chaput and Claytor 1988). A smolt monitoring program in the Margaree River was initiated in 2001 (Clément et al. 2007).

Stock status in SFA 18 is based on angling catch information and juvenile abundance. Returns to Margaree River are estimated using various techniques. For years 1970 to 1987, angling catch divided by the range of exploitation rates with a maximum exploitation rate of 0.37 and a minimum of 0.215 was used (Chaput and Jones 1992). From 1987 to 1996, estuary trapnets were set-up in Margaree River to provide more detailed data on Atlantic salmon returns. For 1987 to 2008, angling catch and effort data from logbooks and provincial license stubs are used to derive the returns (Chaput and Breau, In prep.). The catchability coefficient per rod day is estimated from angling catch and effort for the years 1988 to 1996 when a mark and recapture program was used to estimate returns, independently from angling catch. Spawners for 1970 to 2008 equal returns minus removals; removals for 1984 to 2008 consist of the retained angling catch for small salmon and a hook and release mortality estimate of 5% for small salmon and large salmon angling released catch.

Returns and spawners to SFA 18 are derived from estimates of returns and spawners to the Margaree River, adjusted for the ratio of the SFA 18 angling catch to the Margaree River catch.

Abundance and trends are evaluated relative to the recent 15 years, 1994 to 2008, when available. This time period has been chosen because it roughly represents 3 generations and also corresponds to the years since the moratorium on salmon commercial fishing in insular Newfoundland (1992). Abundances are also put in context of the longer time period when available. The trend in an abundance index (Ln(Index)) is characterized as the instantaneous rate of change (Z) over the period 1994 to 2008. Change in abundance for the most recent 15 year period is expressed as $(\exp^{Z*15}-1)$.

ABUNDANCE AND RECENT TRENDS

Status, population size and trends of adult salmon in monitored rivers

Returns and spawners estimate for Margaree River indicate adequate numbers of fish to meet conservation requirement (small salmon: 582 and large salmon: 1,036; Claytor et al. 1987; Table 8). Salmon returns to the Margaree River have exceeded conservation requirement every year since 1985, with an average of 295% of conservation requirements for the past 15 years

(Table 8, 9). Small salmon return estimates for the past three generations (1994-2008) ranged from a minimum of 441 to a maximum of 3,041 fish (Table 9, Fig. 3). Large salmon return estimates for the same time period (1994-2008) ranged from a minimum of 1,528 to a maximum of 5,918 fish (Table 9; Fig. 3). The large salmon return estimate for Margaree River shows a decline of 6% for the past three generations and an increase of 31% is observed for small salmon (Table 8).

During the late 1980s and early 1990s, catches of salmon and catch rates in selected rivers were greater than in recent years. Angling catches in Margaree River declined by 24% for total salmon and by 29% for large salmon over the last three generations (Table 8, Fig. 3; Appendix 1). The catch per unit effort on the other hand had increasing trends for total salmon (15%) and large salmon (8%).

During the past three generations, total salmon caught (uncorrected for effort) declined by 75% in River Philip, 23% in East River (Pictou) and 36% in West River (Antigonish) (Table 8; Fig. 4; Appendices 2 - 5). Catches, corrected for effort, declined by 62 % in River Philip and 22% in West River (Antigonish) whereas catch rate increased by 15% in East River (Pictou) (Table 7). Assessments conducted in the 1990s determined that returns to River Philip, East River (Pictou) and West River (Antigonish) met and exceeded conservation requirements (O'Neil et al. 1996).

Angling data for other rivers is presented in Appendices 2 to 9.

Total abundance of Atlantic salmon adults in SFA 18

Small salmon returns to SFA 18 have been estimated to be greater in the 1980s to 2008 compared to earlier years (Fig. 5). Small salmon return estimates for the past three generations range from a minimum of 508 to a maximum of 8,253 (Table 10, Fig. 5). Estimates of small salmon returns to SFA 18 increased by 34% during the past 15 years and by 74% over the period 1970 to 2008 (Fig. 5). Return estimates for large salmon increased with the closure of the commercial fisheries in 1984. Since then, the minimum and maximum range of return estimates varied between 1,196 and 13,748 for large salmon (Table 10; Fig. 5). Two-sea-winter salmon represent between 77% and 87% of large salmon returns and spawners in SFA 18.

AREA OF OCCUPANCY

During the summer and fall of 2008, an extensive electrofishing survey of rivers in Gulf Nova Scotia was conducted to quantify the presence of Atlantic salmon and to inform on area of occupancy. During 2008, 23 rivers (36 sites) were electrofished to gather data. Data collected by the DFO Science Branch and the regional Antigonish office (Charles MacInnis, DFO) in years prior to 2008 were also used for rivers not visited during 2008.

In total, presence/absence data for salmon was obtained for 55 rivers during 2005 to 2008 (Table 1, 11; Fig. 6). Salmon presence is known for 43 of these rivers, but no salmon records either from fisheries or juvenile surveys were recorded for 12 rivers (Table 1). Sixteen rivers were electrofished for the first time in 2008: Red River, MacKenzies River, Smiths Bk, Mill Bk, Judique Intervale Bk, Graham River, Campbells Bk, Chisholm Bk, Mill Bk (Strait of Canso), Wrights R., Baileys Bk., Pine Tree Bk., Haliburton Bk., Big Caribou R., Toney R. and Shinimicas R. Fry, parr or both age-classes were present in 40 of the 51 rivers with juvenile data; of which 15 rivers had only presence/absence information. Both age-classes were caught in 17 of the 24 rivers with density information; fry only were caught in one river and parr only were caught in the remaining six rivers. Of the 23 rivers electrofished in 2008, seven had been surveyed in the past. Fry were found in four of these seven rivers in 2008 indicating spawning in fall 2007 (Table 11; Fig. 6; Appendices 10 - 12). This is down from all seven rivers having fry in past surveys. Parr (one-year and two-year old) were found in five of these seven rivers in 2008. This is down from all seven rivers having parr in past surveys. Rivers having only parr present possibly indicated that 1) no spawning during fall 2007 or, 2) no fry in the selected sites.

In 2008, Inverness County experienced a large rainfall event, which could account for the absence of salmon in Red River, Rigwash Brook, Smiths Brook, Mills Brook and Mabou River; rivers known to be inhabited by salmon. However, no decline was observed in Margaree River which is also in Inverness County. Surveys on Corney Brook and Antony Aucoin's Brook did not reveal the presence of salmon. In Captains Brook, salmon were found in 2003 (Charles MacInnis, personal communication) but, no salmon were found during the electrofishing survey in 2008. Site selection could have led to the absence of salmon at some sites in the 2008 survey. Sites on Fiset Brook had salmon except for the two sites above the falls, which is a natural barrier to upstream movement. In Pine Tree Brook, no salmon were detected in the survey however; one parr was present in the test trial indicating that salmon are present in the stream. Salmon were not found in Haliburton Brook, Big Caribou River and Toney Brook, which are low gradient streams although Toney Brook visually has good salmon habitat.

FRESHWATER PRODUCTION

Time series data on juvenile densities, to assess abundance and trends, are available from selected rivers of SFA 18 (Margaree River, River Philip, Wallace River, West River (Antigonish), East River (Pictou), Chéticamp River) (Figs. 7 - 10; Appendices 10 - 12). The longest time series is for the Margaree River, dating to 1957 (Chaput et al. 1989; LeBlanc et al. 2003). Densities of fry and parr are assessed relative to a "normal index of abundance" (Elson norm) of 29 fry per 100 m^2 and 38 parr per 100 m^2 (DFO 2002).

In the Margaree River, fry density increased rapidly during the past three generations and remains at a very high level (Fig. 7, Appendix 9). During the past three generations, mean parr densities in Margaree River have exceeded Elson norm of 38 parr per 100m^2 (Fig. 7). Similar mean densities have been observed in River Philip, Wallace River, West River (Antigonish), East River (Pictou) and Chéticamp River during the same time period (Figs. 8 to 10). During the past three generations, mean fry densities in these rivers, with the exception of two years on the Wallace River and one year on the Chéticamp River, have been above Elson norm at the other annually assessed rivers in SFA 18 (Figs. 8 - 10).

Smolt monitoring

In 2001, a smolt monitoring program was established on Margaree River to obtain detailed information on biological characteristics of smolts and to estimate smolt production (Clément et al. 2007). To date, eight years (2001-2008) of data have been gathered for the Margaree River.

In rivers of SFA 18, the majority of the smolts migrate to the ocean from mid-May to mid-June predominantly as 2-year and 3-year old fish. In Margaree River, smolt age by year class (cohort) consist of 2-year (36-67%), 3-year (31-57%), 4-year (1-9%) and occasionally 5-year old (0-1%) fish (Table 12). The number of smolts produced per large salmon return varies between 33 and 47 smolts. Estimated run size of smolts migrating to the ocean has ranged from 63,200 to 114,200 for the time period 2002 to 2008 (Table 13). The Margaree River is estimated to contain 2.8 million m^2 of juvenile rearing habitat (Marshall 1982). Based on the available rearing habitat, between 2.3 and 4.1 smolts per 100 m^2 are produced (Table 13). Female smolts comprise more than 70% of the smolt run.

SEA SURVIVAL

The return rate of smolts to small and large salmon has varied between 0.3% and 0.9% for small salmon and between 2.4% and 6.2% for large salmon (Table 14).

THREATS

In the context of the identification and management for species at risk, a *threat*, is 'an activity or process (both natural and anthropogenic) that has caused, is causing, or may cause harm, death, or behavioural changes to a species at risk or the destruction, degradation, and/or impairment of its habitat to the extent that population-level effects occur' (Environment Canada 2006). In essence, a threat is an activity that imposes a *stress* on a species at risk population which contributes to or perpetuates its decline, or limits its recovery. In the case of Atlantic salmon, the elevated marine mortality and declining returns in recent years are stress caused by unknown threats (DFO and MNRF *In prep b*).

A semi-quantitative assessment of the impact of all threats to salmon is summarized in Table 15. The principal habitat-related threats are: habitat alteration including habitat fragmentation due to non compliant culverts, municipal waste water treatment facilities and cumulative effect of ecosystem changes (DFO and MNRF *In prep b*). Table 16 provides a list of man-made barriers currently present in rivers of SFA 18. The cumulative effect of these threats represents a loss of 5 to 30% of spawners. All other threats represent less than 5 % of spawners lost. Many of these activities can be regulated under various sections of the *Fisheries Act*.

There are man-made obstructions to fish migrations in a few rivers of SFA 18 (Table 16). Only a few of these barriers have bypass capabilities for salmon (both barriers on South River and East River (Pictou)). Several barriers have been removed in recent years and work to provide access to previously inaccessible areas is ongoing (Waugh River; Davidson Brook in River Philip).

Brown trout, a non-native species, has been present in several rivers of SFA 18 since the early 1900s and there are self-sustaining populations in many rivers of the mainland portion of SFA 18. Negative impacts of brown trout on Atlantic salmon are considered low. Smallmouth bass, an invasive species to the Maritimes, inhabit seven lakes in three rivers of SFA 18, the most recent introduction having occurred in Lake Ainslie, a headwater lake of the Southwest Margaree River (DFO 2009). Interactions between smallmouth bass and Atlantic salmon are unknown but not thought to be positive (DFO 2009). The bacterial kidney disease also occurs in these systems and the impact on wild fish is considered low.

REFERENCES

Cameron, J.D. and R.W. Gray. 1979. Estimated densities of juvenile Atlantic salmon and other freshwater fishes in selected Nova Scotia streams, 1978. Can. Data Rep. Fish. Aquat. Sci. No. 163.

Chaput, G.J. and R.R. Claytor. 1988. Sport catch of Atlantic salmon from the Margaree River, Nova Scotia, 1947 to 1987. Can. Data Rep. Fish. Aquat. Sci. No. 678.

Chaput, G.J. and R.R. Claytor. 1989. Electrofishing surveys for Atlantic salmon from Margaree River, Nova Scotia, 1957 to 1987. Can. Data Rep. Fish. Aquat. Sci. 736.

Chaput, G. and R. Jones. 1992. Stock-Recruit Relationship for Multi-Sea-Winter Salmon from the Margaree River, N.S. CAFSAC Res. Doc. 92/124.

Chaput, G.J., R. Jones, L. Forsyth, and P. LeBlanc. 1993. Assessment of Atlantic salmon in the Margaree River, Nova Scotia, 1992. DFO Atlantic Fisheries Res. Doc. 93/14.

Chaput, G., P. Cameron, D. Moore, D. Cairns, and P. LeBlanc. 2006a. Stock status of Atlantic salmon (*Salmo salar* L.) from rivers of the Gulf Region, SFA 15 to 18. DFO. Can. Sci. Advis. Sec. Res. Doc. 2006/023.

Chaput, G., J.B. Dempson, F. Caron, R. Jones, and J. Gibson. 2006b. A synthesis of life history characteristics and stock grouping of Atlantic salmon (*Salmo salar* L.) in eastern Canada. DFO. Can. Sci. Advis. Sec. Res. Doc. 2006/015.

Chaput, G. and C. Breau. In prep. Estimation of Margaree River Atlantic salmon returns using a Bayesian framework.

Claytor, R.R., G.J. Chaput., and T.G. Lutzac. 1987. Assessment of Atlantic salmon, (*Salmo salar*), in the Margaree River, 1987. CAFSAC Res. Doc. 87/105.

Claytor, R.R. 1996. Weekly fish counts from in-river traps, counting fences, barrier pools, and fishways in southern Gulf of St. Lawrence rivers, from 1952 to 1993. Can. Data Rep. Fish. Aquat. Sci. No. 982.

Clément, M., G. Chaput, and P. Leblanc. 2007. Atlantic salmon (*Salmo salar*) smolt migration from the Margaree River, 2001 to 2003. Can. Tech. Rep. Fish. Aquat. Sci. 2693.

DFO, 2002. Atlantic Salmon Maritime Provinces Overview for 2001. DFO Science Stock Status Report D3-14(2002).

DFO, 2003. Atlantic salmon Maritime provinces overview for 2002. DFO Science Stock Status Report 2003/026.

DFO 2009. Potential impact of smallmouth bass introductions on Atlantic salmon: a risk assessment. DFO. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/003.

DFO and MNRF. In prep b. Conservation Status Report: Atlantic salmon in Atlantic Canada and Québec PART II Anthropogenic Considerations. Can. Man. Rep. Fish. Aquat. Sci. No. xx.

Environment Canada 2006. Guidelines on identifying and mitigating threats to species at risk (Draft Sept 27, 2006) pp1-29 *In* Species at Risk Act Implementation Guidance.

Landry, D., G. Chaput, and J. Bridgland. 2005. Stock Status of Atlantic Salmon (*Salmo salar*) in the Cheticamp River, Cape Breton Highlands National Park, Nova Scotia, for 2004. DFO CSAS Res. Doc. 2005/22.

LeBlanc, P.H. and G. Chaput. 2003. Electrofishing surveys for Atlantic salmon (*Salmo salar* L.) from the Margaree River, Nova Scotia, 1988 to 2000. Can. Data Rep. Fish. Aquat. Sci. 1128.

LeBlanc, P.H., R.A. Jones, and G. Chaput. 2005. Biological characteristics of adult Atlantic salmon (*Salmo salar* L.) from the Margaree River, Nova Scotia, 1987 to 1996. Can. Data Rep. Fish. Aquat. Sci. 1172.

Marshall, T.L. 1982. Background and management alternatives for salmon of the Margaree River: a working document for the selection of stock enhancement strategies. Fisheries and Oceans, Halifax, NS. Mimeo.

Marshall, T.L., L. Forsyth, R. Jones, P. Leblanc, and K. Rutherford. MS 1997. Status of Atlantic salmon stocks in selected rivers of Cape Breton, 1996. DFO. Can. Sci. Advis. Sec. Res. Doc. 97/23.

Newbould, K.A. 1983. Hatchery salmonid production and distribution (1976-82), Nova Scotia, New Brunswick and Prince Edward Island. Can. Data Rep. Fish. Aquat. Sci. No. 410.

O'Connell, M.F., J.B. Dempson, and G. Chaput. 2006. Aspects of the Life History, Biology, and Population Dynamics of Atlantic Salmon (*Salmo salar* L.) in Eastern Canada. DFO. Can. Sci. Advis. Sec. Res. Doc. 2006/014.

O'Connell, D., Reddin, G., Amiro, P.G., Caron, F., Marshall, T.L., Chaput, G., Mullins, C.C.,Locke, A., O`Nei1, S.F., and Cairns, D.K. 1997. Estimates of conservation spawners requirements for Atlantic salmon (*Salmo salar* L.) for Canada. DFO CSAS Res. Doc. 97/100.

O'Neil, S.F., D.A. Longard, and C.J. Harvie. 1996. Atlantic salmon (*Salmo salar* L.) stock status on rivers in the Northumberland Strait, Nova Scotia areas, in 1996. DFO. CSAS Res. Doc. 97/22.

O'Neil, S.F., K.A. Rutherford and D. Aitken. 2000. Atlantic salmon (*Salmo salar* L.) stock status on rivers in the Northumberland Strait, Nova Scotia area, in 1999. DFO. Can. Sci. Advis. Sec. Res. Doc. 2000/007.

Table 1. Area of occupancy of Atlantic salmon for rivers of Salmon Fishing Area 18 flowing into the Northumberland Strait. Rivers are listed from East to West (see Fig. 2 for map). Evidence of salmon presence (X = present, A = absent) includes adult sampling and angling catches (Adult) and juvenile monitoring (Juvenile). Habitat areas are from various published and unpublished sources and have been previously summarized in Chaput et al. (2006a).

Map number	River	Longitude (W)	Latitude (N)	Egg requirement (million)	Drainage area (km²)	Fluvial area (million m²)	Adult	Juvenile
	Cape Breton							
1	Salmon River	-60.49356	47.00033					X
2	Blair River	-60.6992	46.9167	0.23	58	0.0974	X	
3	Red River	-60.7658	46.8500	0.14	35	0.0588		X
4	Grande Anse River	-60.7992	46.8333	0.20	51	0.0852	X	X
5	Mackenzies River	-60.8325	46.8167	0.30	75	0.1244	X	X
6	Fishing Cove River	-60.8825	46.8000	0.13	31	0.0521	X	
7	Corneys Brook	-60.92544	46.72367					A
8	Anthony Aucoin's Brook	-60.9528	46.67339					A
9	Rigwash Brook	-60.9528	46.67339					A
10	Chéticamp River	-60.9492	46.6667	0.77	298	0.3220	X	X
11	Aucoin Brook	-60.98086	46.60678					X
12	Fiset Brook	-61.00525	46.60283					X
13	Farm Brook	-61.0154	46.58214					X
14	Margaree River	-61.0992	46.4333	6.71	1,100	2.7976	X	X
15	Smiths Brook	-61.2684	46.26394					A
16	Broad Cove River	-61.3029	46.16544					X
17	Mill Brook	-61.4488	46.14311					A
18	Northeast Mabou River	-61.4158	46.0833	1.02	254	0.4242	X	X
19	Southwest Mabou River	-61.4325	46.0667	0.37	123	0.1540	X	X
20	Mabou River	-61.3825	46.0667	0.56	188	0.2351	X	X
21	Captains Brook	-61.5041	45.97572					A
22	Judique Intervale Brook	-61.4742	45.9000	0.18	44	0.0738	X	X
23	Graham River	-61.4912	45.86111					X
24	Campbells Brook	-61.4843	45.84911					X
25	Chisholm Brook	-61.4825	45.8167	0.07	17	0.0279	X	X
26	Mill Brook (Strait of Canso)	-61.4219	45.66947					X

Table 1 (continued).

Map number	River	Longitude (W)	Latitude (N)	Egg requirement (million)	Drainage area (km^2)	Fluvial area (million m^2)	Adult	Juvenile
	Mainland Nova Scotia							
27	Wrights River	-61.5175	45.66708				X	X
28	Tracadie River	-61.6158	45.6167	0.13	120	0.0525	X	
29	Afton River	-61.7325	45.6333	0.05	43	0.0189	X	X
30	Pomquet River	-61.7992	45.6000	0.19	176	0.0769	X	X
31	South River	-61.9158	45.6000	0.23	217	0.0950	X	X
32	West River (Antigonish)	-61.9658	45.6167	1.15	353	0.4803	X	X
33	North River	-61.9391	45.6661					X
34	MacInnis Brook	-61.91686	45.8086					A
35	Doctors Brook	-62.12002	45.7777					A
36	Vameys Brook	-62.2685	45.70116					X
37	Baileys Brook	-62.2698	45.69206					X
38	Barneys River	-62.3492	45.6667	0.51	156	0.2128	X	X
39	French River (Merigomish)	-62.4492	45.6333	0.42	128	0.1740	X	X
40	Russell Brook	-62.4882	45.5803					X
41	Sutherlands River	-62.4992	45.5833	0.16		0.0666	X	X
42	Pine Tree Brook	-62.5448	45.60108					A
43	East River (Pictou)	-62.6992	45.6500	1.75	536	0.7291	X	X
44	Middle River (Pictou)	-62.7325	45.6500	0.71	217	0.2953	X	X
45	West River (Pictou)	-62.7658	45.6667	0.80	245	0.3326	X	X
46	Haliburton Brook	-62.7592	45.698					A
47	Big Caribou River	-62.843	45.73792					A
48	Toney River	-62.9025	45.75553					A
49	River John	-63.0658	45.7500	0.95	292	0.3973	X	X
50	Waughs River	-63.2992	45.7333	0.75	230	0.3132	X	X
51	French River	-63.3262	45.7037					X
52	Wallace River	-63.5158	45.8167	1.50	458	0.6229	X	X
53	Pugwash River	-63.6658	45.8500	0.59	182	0.2470	X	X
54	River Philip	-63.7325	45.8500	2.31	726	0.9621	X	X
55	Shinimicas River	-63.90944	45.86644					X

Table 2. Sea-age spawning histories of wild Atlantic salmon by size groups combined for summer and fall, from the Margaree River, 1987 to 1996 (LeBlanc et al. 2005).

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	All years
1SW	17	201	75	153	137	183	169	90	118	259	1,402
2SW	91	126	270	204	160	703	295	319	284	346	2,798
3SW	11	2	21	36	3	46	15	12	14	10	170
1C	1	0	1	1	0	6	1	1	0	0	11
1A	1	0	0	2	5	7	3	1	0	1	20
2C	2	17	27	0	1	6	1	5	10	5	74
2A	3	6	6	18	7	23	17	27	12	29	148
2CR	0	2	0	0	0	0	1	0	1	2	6
2AR	1	0	0	4	3	11	8	7	7	6	47
3R	0	3	4	10	3	10	7	5	4	6	52
Unknown	2	11	2	6	3	27	10	52	52	53	218
Total	129	368	406	434	322	1022	527	519	502	717	4,946
Prop. 1SW	0.13	0.56	0.19	0.36	0.43	0.18	0.33	0.19	0.26	0.39	0.30
Prop. 2SW	0.72	0.35	0.67	0.48	0.50	0.71	0.57	0.68	0.63	0.52	0.59
Prop. 3SW	0.09	0.01	0.05	0.08	0.01	0.05	0.03	0.03	0.03	0.02	0.04
Prop. Repeat spawners	0.06	0.08	0.09	0.08	0.06	0.06	0.07	0.10	0.08	0.07	0.08
Prop. maiden	0.94	0.92	0.91	0.92	0.94	0.94	0.93	0.90	0.92	0.93	0.92

1C: mature as a 1SW or 2SW and returned for a second spawning as a consecutive spawner;
1A: mature as a 1SW or 2SW and returned for a second spawning as an alternate spawner;
2CR: mature as a 1SW or 2SW and returned for a third or greater spawning as a consecutive spawner;
2AR: mature as a 1SW or 2SW and returned for a third or greater spawning as an alternate;
3R: matured as a 3SW and returned with either a consecutive or an alternate spawning history.

Table 3. Proportion of female by maiden sea age in Atlantic salmon from the Margaree River based on samples collected at the estuary trapnets, 1987 to 1996 (modified from LeBlanc et al. 2005).

Maiden 1SW (small salmon)				
Year	Male	Female	Total	Prop. Female
1987	4	1	5	0.20
1988	93	26	119	0.22
1989	39	30	69	0.43
1990	115	33	148	0.22
1991	.	.	.	.
1992	133	10	143	0.07
1993	62	9	71	0.13
1994	32	6	38	0.16
1995	75	5	80	0.06
1996	109	5	114	0.04
Total	662	125	787	0.16

Maiden 2SW (large salmon)				
Year	Male	Female	Total	Prop. Female
1987	27	35	62	0.56
1988	28	82	110	0.75
1989	77	186	263	0.71
1990	68	130	198	0.66
1991	.	.	.	.
1992	151	454	605	0.75
1993	37	91	128	0.71
1994	47	172	219	0.79
1995	70	164	234	0.70
1996	58	135	193	0.70
Total	563	1449	2012	0.72

Maiden 3SW (large salmon)				
Year	Male	Female	Total	Prop. Female
1987	0	9	9	1.00
1988	0	2	2	1.00
1989	1	20	21	0.95
1990	7	29	36	0.81
1991	.	.	.	.
1992	6	33	39	0.85
1993	1	11	12	0.92
1994		10	10	1.00
1995	0	12	12	1.00
1996	2	7	9	0.78
Total	17	133	150	0.89

Table 4. Maximum, minimum and mean fork length (cm) of wild maiden 1SW, 2SW and 3SW Atlantic salmon from the Margaree River based on samples collected at the estuary trapnets, 1987 to 1996 (modified from LeBlanc et al. 2005).

Year	Maiden 1SW (small salmon)				Maiden 2SW (large salmon)				Maiden 3SW (large salmon)			
	Max	Min	Mean	N	Max	Min	Mean	N	Max	Min	Mean	N
1987	58.0	49.0	53.9	17	86.0	67.0	76.1	91	100.0	74.0	89.0	11
1988	64.5	48.5	56.1	201	90.0	68.0	76.6	126	88.5	88.0	88.3	2
1989	62.5	48.5	56.0	75	85.0	64.5	75.5	270	104.0	85.5	91.3	21
1990	64.0	48.0	56.5	153	85.5	62.5	75.6	204	95.0	81.0	87.8	36
1991	60.5	44.5	52.7	137	83.0	66.0	72.9	160	90.5	84.0	87.8	3
1992	65.9	47.0	56.7	183	92.5	66.0	75.7	703	95.0	80.5	87.7	46
1993	63.5	47.5	54.7	169	84.5	64.0	75.2	295	93.5	82.5	88.9	15
1994	66.3	44.8	56.6	90	86.7	66.5	76.0	319	96.5	82.8	89.9	12
1995	62.4	41.0	54.4	118	87.8	66.0	75.4	284	96.0	85.9	90.1	14
1996	65.3	49.0	55.7	259	93.5	66.5	75.6	346	94.0	82.5	89.3	10
Mean	63.3	46.8	55.3	1,402	87.5	65.7	75.5	2,798	95.3	82.7	89.0	170

Table 5. Proportion of repeat-spawning male and female Atlantic salmon from the Margaree River based on samples collected at the estuary trapnets, 1987 to 1996 (LeBlanc et al. 2005).

1SW Alternate				
Year	Male	Female	Total	Prop. Female
1987	0	1	1	1.00
1988	.	.	.	.
1989	.	.	.	.
1990	1	1	2	0.50
1991	.	.	.	.
1992	4	1	5	0.20
1993	1	0	1	0.00
1994	1	0	1	0.00
1995	.	.	.	.
1996	1	0	1	0.00
Total	8	3	11	0.27

1SW Consecutive				
Year	Male	Female	Total	Prop. Female
1987	1	0	1	0.00
1988	.	.	.	.
1989	0	1	1	1.00
1990	1	0	1	0.00
1991	.	.	.	.
1992	5	1	6	0.17
1993	1	0	1	0.00
1994	1	0	1	0.00
1995	.	.	.	.
1996	.	.	.	.
Total	9	2	11	0.18

2SW Alternate				
Year	Male	Female	Total	Prop. Female
1987	0	3	3	1.00
1988	2	4	6	0.67
1989	1	5	6	0.83
1990	2	16	18	0.89
1991	.	.	.	.
1992	3	14	17	0.82
1993	0	10	10	1.00
1994	1	23	24	0.96
1995	1	11	12	0.92
1996	2	14	16	0.88
Total	12	100	112	0.89

2SW Consecutive				
Year	Male	Female	Total	Prop. Female
1987	0	2	2	1.00
1988	1	14	15	0.93
1989	1	26	27	0.96
1990	.	.	.	.
1991			.	.
1992	1	5	6	0.83
1993	.	.	.	.
1994	2	2	4	0.50
1995	1	6	7	0.86
1996	1	3	4	0.75
Total	7	58	65	0.89

3SW Alternate				
Year	Male	Female	Total	Prop. Female
1987	.	.	.	.
1988	0	1	1	1.00
1989	.	.	.	.
1990	1	2	3	0.67
1991	.	.	.	.
1992	0	7	7	1.00
1993	0	4	4	1.00
1994	0	3	3	1.00
1995	0	1	1	1.00
1996	0	2	2	1.00
Total	1	20	21	0.95

3SW Consecutive				
Year	Male	Female	Total	Prop. Female
1987	.	.	.	.
1988	0	2	2	1.00
1989	0	2	2	1.00
1990	0	5	5	1.00
1991			.	.
1992	0	2	2	1.00
1993	1	0	1	0.00
1994	.	.	.	.
1995	0	3	3	1.00
1996	0	3	3	1.00
Total	1	17	18	0.94

Table 6. Maximum, minimum and mean fork length (cm) of wild repeat-spawning Atlantic salmon from the Margaree River based on samples collected at the estuary trapnets, 1987 to 1996 (LeBlanc et al. 2005).

	1 Alternate				1 Consecutive				2 Alternate				2 Consecutive			
Year	Max	Min	Mean	N	Max	Min	Mean	N	Max	Min	Mean	N	Max	Min	Mean	N
1987	78.0	78.0	78.0	1	60.0	60.0	60.0	1	92.0	90.5	91.3	3	81.0	79.0	80.0	2
1988	.	.	.	.	.	.	.	.	100.0	92.0	95.8	6	97.5	83.0	91.2	17
1989	.	.	.	.	67.0	67.0	67.0	1	96.0	90.0	93.3	6	104.0	88.5	95.7	27
1990	92.0	82.0	87.0	2	69.0	69.0	69.0	1	96.0	89.0	93.8	18	.	.	.	.
1991	80.5	69.5	75.3	5	.	.	.	.	91.5	86.5	88.2	7	77.0	77.0	77.0	1
1992	89.5	65.0	79.5	7	71.2	62.0	67.4	6	100.0	85.5	93.2	23	88.5	77.5	83.6	6
1993	84.0	74.2	78.7	3	69.0	69.0	69.0	1	97.0	85.0	91.3	17	83.5	83.5	83.5	1
1994	87.3	87.3	87.3	1	65.0	65.0	65.0	1	97.0	85.0	92.2	27	90.5	76.5	83.0	5
1995	.	.	.	.	.	.	.	.	96.5	86.5	92.3	12	90.0	78.6	84.3	10
1996	82.0	82.0	82.0	1	.	.	.	.	98.0	80.1	91.8	29	86.2	75.6	81.0	5
Mean	84.8	76.9	81.1	20	66.9	65.3	66.2	11	96.4	87.0	92.3	148	88.7	79.9	84.4	74

Table 7. Stocking history of rivers located in SFA 18. Information from 1976 to 1982 is based on Newbould (1983); 1983 to current (Chaput et al. 2006a).

River	Origin of fish stocked	Life stages	Range in numbers of fish stocked annually	Range in years when stocking occurred
Margaree R.	Miramichi R.	Fry, parr, smolts	19,000 – 409,000	1895 -97; 1930-31; 1956-57; 1963-72; 1977
	Saint John R.	Fry	8,000 - 4,600,000	1902-09
	Morell R.	Parr	650,000	1932-33
	R. Philip	Parr	9,000	1956
	New Mills/Restigouche R.	Smolt	15,000	1962-73
	Rocky Brook/ Miramichi R.	Parr, Smolt	15,000 – 16,000	1978-81; 1984-86
	Margaree R.	Fry, parr, smolt	2,000-140,000	1986-2008
Philip R.	Philip R.	Fry, Parr	400-40,000	1982-98 (except 1985, 1987-88, 1994); 2000
	Waweig R.	Parr	5,000	1976
	West R. St Mary's	Parr	8,000	1977
	East R. Sheet Harbour	Parr	5,000	1978
	Little Southwest Miramichi R.	Parr	2,000	1979
	St Mary's R.	Parr	6,000	1979
East R. Pictou	East R. Pictou	Parr	4,000-5,000	1995 and 2002
French R. Pictou	East R. St Mary's	Fry	2,000	1988
Middle R. Pictou	Margaree R. X Rocky Brook	Parr	2,000	1983
	East R. Pictou	Fry, Parr	1,200 – 56,000	1983; 1987- 94; 1996-98
Grand Anse R.	Margaree R. X Rocky Brook	Smolt	2,000	1983

Table 8. Summary of status indicators and trends for four index rivers in SFA 18, 1994 to 2008.

	Life stage	Margaree River		River Philip		East River (Pictou)		West River (Ant.)	
		Level	Trend	Level	Trend	Level	Trend	Level	Trend
Angling catch (No. of fish)	Adult	1,649	-24%	269	-75%	125	-23%	250	-36%
	Large	1,207	-29%	173	-83%	85	-36%	149	-61%
Catch per rod days	Adult	0.19	+15%	0.24	-62%	0.25	15%	0.38	-22%
	Large	0.14	+8%	0.15	-75%	0.16	-5%	0.22	-45%
Estimated return	Large	2,797	-6%						
	Small	950	31%						
Relative to conservation requirements	Return	295%	Exceeded every year since 1985						
Juvenile abundance (fish / 100 m²)	Fry	120	-14%	114		131		200	
	Parr	73	+6%	47		34		74	
	Distribution of juveniles	Present at all 13 sites sampled	No contraction	Common		Common		Common	
Large salmon in returns (%)	Adult	69%		92%		89%			
Maiden salmon in returns (%)	Adult	92%		89%		87%		90%	
Maiden age structure 1SW-2SW-3SW (%)	Adult	34%-62%-4%		9%-90%-1%		13%-85%-2%			
Smolt ages/returns 2-3-4 (%)	Small	59%-38%-3%		76%-23%-1%		41%-59%-0		57%-37%-6%	
	Large	64%-35%-1%		84%-16%-0		74%-26%-0			
Female in 1SW-2SW-3SW (%)	Adult	16%-73%-92%		4%-68%-100%		9%-69%-100%		2% - ? - ?	
Fork length (cm) of 1SW-2SW-3SW	Adult	56 – 76-89		56 – 75 - 86		57 – 76 – 89		57 – 77 - 92	

Table 9. Minimum and maximum estimates of small salmon and large salmon returns and spawners for Margaree River, 1970 to 2008.

Year	Small salmon				Large salmon			
	Returns		Spawners		Returns		Spawners	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1970	230	395	145	310	581	1,000	366	785
1971	57	98	36	77	254	437	160	343
1972	114	195	72	153	284	488	179	383
1973	449	772	283	606	316	544	199	427
1974	162	279	102	219	289	498	182	391
1975	97	167	61	131	173	298	109	234
1976	259	447	163	351	222	381	140	299
1977	186	321	117	252	378	651	238	511
1978	68	116	43	91	427	735	269	577
1979	1,614	2,777	1,017	2,180	219	377	138	296
1980	451	777	284	610	378	651	238	511
1981	2,430	4,181	1,531	3,282	375	647	236	508
1982	1,868	3,214	1,177	2,523	484	833	305	654
1983	184	316	116	248	402	693	253	544
1984	400	688	154	442	327	583	312	568
1985	634	1,167	126	659	1,109	2,217	1,049	2,157
1986	838	1,420	55	637	2,738	5,680	2,606	5,548
1987	1,353	1,959	381	987	3,245	4,310	3,153	4,218
1988	1,126	1,651	225	750	3,152	4,212	3,053	4,113
1989	728	1,090	154	516	2,614	3,518	2,534	3,438
1990	812	1,217	157	562	2,375	3,197	2,299	3,121
1991	945	1,416	172	643	2,942	4,000	2,852	3,910
1992	819	1,214	120	515	3,001	4,019	2,901	3,919
1993	947	1,340	178	571	1,669	2,193	1,615	2,139
1994	544	817	117	390	2,502	3,392	2,428	3,318
1995	441	674	98	331	1,880	2,565	1,825	2,510
1996	1,960	3,041	721	1,802	4,070	5,605	3,973	5,508
1997	452	717	141	406	4,286	5,918	4,181	5,813
1998	510	809	158	457	2,585	3,578	2,518	3,511
1999	565	904	254	593	1,948	2,720	1,908	2,680
2000	494	814	232	552	1,830	2,604	1,795	2,569
2001	659	1,074	295	710	2,127	3,014	2,084	2,971
2002	681	1,117	318	754	1,528	2,190	1,497	2,159
2003	618	1,029	291	702	2,990	4,246	2,933	4,189
2004	871	1,452	353	934	3,315	4,733	3,245	4,663
2005	633	1,009	215	591	2,762	3,845	2,695	3,778
2006	696	1,139	252	695	2,653	3,743	2,590	3,680
2007	579	970	238	629	1,837	2,643	1,798	2,604
2008	950	1,671	338	1,059	2,797	4,136	2,734	4,073

Estimates of returns for 1987 to 2008 are based on 95% C.I. of Bayesian catch rate model developed by Chaput, March 2008. Data provided by Gérald Chaput, March 31, 2008.

Table 10. Minimum and maximum estimates of small salmon, large salmon and 2SW salmon returns and spawners for SFA 18, 1970 to 2008.

Year	Small salmon				Large Salmon				2SW Salmon			
	Returns		Spawners		Returns		Spawners		Returns		Spawners	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1970	264	1,073	167	842	6,161	7,858	395	1,824	4,744	6,836	304	1,587
1971	65	265	41	208	2,456	3,198	173	797	1,891	2,782	133	694
1972	131	530	82	416	6,095	6,924	193	891	4,693	6,024	148	775
1973	516	2,095	325	1,645	5,376	6,299	215	992	4,140	5,481	165	863
1974	187	757	118	595	7,119	7,963	196	908	5,481	6,928	151	790
1975	112	454	71	357	4,483	4,989	118	544	3,452	4,340	91	473
1976	299	1,212	188	951	3,578	4,223	151	694	2,755	3,674	116	604
1977	215	871	135	684	5,175	6,280	257	1,187	3,985	5,463	198	1,033
1978	78	316	49	248	5,954	7,201	290	1,340	4,585	6,265	223	1,166
1979	1,857	7,536	1,170	5,915	1,676	2,315	149	688	1,290	2,014	115	598
1980	520	2,108	327	1,655	4,846	5,951	257	1,187	3,732	5,177	198	1,033
1981	2,797	11,348	1,762	8,908	3,234	4,332	255	1,181	2,490	3,769	196	1,027
1982	2,150	8,722	1,354	6,847	5,370	6,783	329	1,519	4,135	5,901	253	1,322
1983	212	858	133	674	4,848	6,024	273	1,264	3,733	5,241	210	1,100
1984	460	1,867	177	1,200	3,105	4,107	337	1,320	2,391	3,573	259	1,148
1985	730	3,167	145	1,788	1,196	5,150	1,131	5,010	921	4,481	871	4,359
1986	965	3,854	63	1,729	2,953	13,195	2,811	12,889	2,274	11,479	2,164	11,213
1987	1,557	5,316	439	2,679	3,500	10,012	3,400	9,798	2,695	8,711	2,618	8,524
1988	1,296	4,481	259	2,035	3,399	9,785	3,293	9,555	2,617	8,513	2,535	8,313
1989	838	2,958	178	1,400	2819	8,172	2,732	7,986	2,171	7,110	2,104	6,948

Estimates for the time series may have changed due to updated values of ratio of SFA 18 to Margaree angling catches for the period 1984 to 2008.

Estimates of returns for 1987 to 2008 are based on 95% C.I. of Bayesian catch rate model developed by Chaput, March 2008.

Data provided by Gérald Chaput, March 31, 2008.

Table 10 (continued). Estimates of small salmon, large salmon and 2SW salmon returns and spawners for SFA 18, 1970 to 2008.

Year	Small salmon				Large Salmon				2SW Salmon			
	Returns		Spawners		Returns		Spawners		Returns		Spawners	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1990	934	3,303	180	1,525	2,561	7,427	2,479	7,250	1,972	6,461	1,909	6,308
1991	1,088	3,843	198	1,745	3,173	9,292	3,075	9,082	2,443	8,084	2,368	7,901
1992	943	3,295	139	1,398	3,236	9,336	3,129	9,104	2,492	8,123	2,409	7,921
1993	1,090	3,637	205	1,550	1,800	5,094	1,741	4,968	1,386	4,432	1,341	4,322
1994	626	2,217	134	1,059	2,698	7,880	2,619	7,708	2,078	6,855	2,016	6,706
1995	508	1,829	113	898	2,027	5,959	1,969	5,832	1,561	5,184	1,516	5,074
1996	2,256	8,253	830	4,890	4,389	13,021	4,285	12,795	3,380	11,328	3,299	11,132
1997	521	1,947	163	1,103	4,622	13,748	4,509	13,503	3,559	11,960	3,472	11,748
1998	587	2,195	181	1,240	2,788	8,312	2,715	8,156	2,147	7,231	2,091	7,096
1999	651	2,454	293	1,610	2,101	6,319	2,057	6,225	1,618	5,497	1,584	5,416
2000	569	2,209	267	1,498	1,974	6,049	1,936	5,968	1,520	5,263	1,491	5,192
2001	758	2,915	339	1,927	2,294	7,002	2,248	6,902	1,766	6,091	1,731	6,005
2002	783	3,031	366	2,046	1,648	5,087	1,615	5,016	1,269	4,426	1,243	4,364
2003	711	2,793	335	1,905	3,225	9,864	3,163	9,731	2,483	8,581	2,436	8,466
2004	1,002	3,940	406	2,535	3,575	10,995	3,499	10,831	2,753	9,566	2,694	9,423
2005	729	2,738	248	1,604	2,979	8,932	2,906	8,776	2,294	7,771	2,238	7,635
2006	801	3,091	290	1,886	2,861	8,695	2,793	8,549	2,203	7,565	2,151	7,438
2007	666	2,632	274	1,707	1,981	6,140	1,939	6,049	1,525	5,342	1,493	5,262
2008	1,094	4,535	389	2,874	3,016	9,608	2,949	9,462	2,323	8,359	2,270	8,232

Estimates for the time series may have changed due to updated values of ratio of SFA 18 to Margaree angling catches for the period 1984 to 2008.

Estimates of returns for 1987 to 2008 are based on 95% C.I. of Bayesian catch rate model developed by Chaput, March 2008.

Data provided by Gérald Chaput, March 31, 2008.

Table 11. Density of juvenile Atlantic salmon for rivers of Salmon Fishing Area 18 for years 2005 to 2008. Number of fry and parr captured are shown in parentheses. Figure 5 shows locations of sites.

River	Location	Longitude (W)	Latitude (N)	Year	Density per $100m^2$	
					Fry	Parr
Anthony Aucoin's Bk	CB Highlands Park	-60.9528	46.67339	2007	0	0
Aucoin Bk	Chéticamp	-60.98086	46.60678	2008	0	9.01 (10)
Baileys Bk	Ponds	-62.2698	45.69206	2008	0	11.70 (11)
Barneys River	Barneys River	-62.3088	45.56924	2007	27.85 (44)	41.14 (65)
Barneys River	Barneys River	-62.3019	45.63639	2005	60.13 (92)	4.58 (7)
Big Caribou River	Waterside	-62.843	45.73792	2008	0	0
Black Avon River	Pomquet	-61.80467	45.58793	2007	Yes*	
Broad Cove River	Inverness	-61.3029	46.16544	2006	4.35 (3)	5.80 (4)
Brown Bk	Middle River in Pictou	-62.7677	45.5931	2008	Yes*	
Campbells Bk	Judique	-61.4843	45.84911	2008	1.03 (1)	1.03 (1)
Captains Bk	Harbourview	-61.5041	45.97572	2008	0	0
Chéticamp River	Roberts Brook	-60.94770	46.64489	2008	8.33 (16)	11.98 (23)
Chéticamp River	Roberts Brook	-60.94475	46.64500	2008	0.92 (3)	5.81(19)
Chéticamp River	Main	-60.92436	46.63081	2008	5.39 (7)	13.85 (18)
Chisholm Bk	Long Point	-61.4778	45.81167	2008	13.75 (11)	10 (8)
Corney Bk	CB Highlands Park	-60.92544	46.72367	2008	0	0
Corney Bk	CB Highlands Park	-60.92531	46.72436	2008	0	0
Doctors Bk	Arisaig	-62.12002	45.7777	2007	No*	
East River	New Glasgow	-62.6525	45.46442	2007	25.92 (92)	5.07 (18)
East River	New Glasgow	-62.6709	45.42447	2007	64.24 (106)	7.27 (12)
East River	New Glasgow	-62.5752	45.41744	2007	29.58 (63)	6.57 (14)
East River	New Glasgow	-62.6893	45.46031	2005	32.77 (39)	10.92 (13)
Farm Bk	Chéticamp	-61.0154	46.58214	2007	19.61 (20)	2.94 (3)
Farm Bk	Chéticamp	-61.021	46.58525	2007	5.16 (11)	1.41 (3)
Fiset Bk	Chéticamp	-61.00525	46.60283	2007	28.76 (44)	20.92 (32)
Fiset Bk	Chéticamp	-61.98947	46.60742	2007	3.97 (5)	27.78 (35)
Fiset Bk	Chéticamp	-60.97683	46.60303	2007	1.48 (2)	31.85 (43)
Fiset Bk	Chéticamp	-60.97586	46.60239	2007	0	0
Fiset Bk	Chéticamp	-60.97497	46.60164	2007	0	0
French River	Merrigomish Harbour	-63.3262	45.7037	2008	Yes*	
French River	Tatamagouche	-63.3262	45.7037	2007	Yes*	
Graham River	Judique	-61.4912	45.86111	2008	6.49 (5)	9.09 (7)
Grande Anse River	Pleasant Bay	-60.77031	46.81642	2007	8.26 (18)	0
Haliburton Bk	Pictou	-62.7592	45.698	2008	0	0
James River	Antigonish	-62.1058	45.58092	2008	75.82 (69)	45.06 (41)
Judique Intervale Bk	Judique Intervale	-61.4779	45.91764	2008	15.70 (19)	16.53 (20)
Mabou River	Mabou	-61.3484	46.08981	2006	13.73 (7)	31.37 (16)
Mabou River	Mabou	-61.3481	46.08986	2006	0	3.45 (1)
Mabou River	Mabou	-61.3165	46.04206	2006	53.97 (34)	77.78 (49)
Mabou River	SW Mabou	-61.4204	45.98131	2006	26.11 (53)	5.42 (11)

Yes*: either fry or parr were present. These sites were electro-fished by staff at the regional office in Antigonish. Coordinates are given for the entrance of the river.

Table 11 (continued).

River	Location	Longitude (W)	Latitude (N)	Year	Density per 100m^2	
Mabou River	SW Mabou	-61.3538	45.91758	2006	15.09 (16)	18.87 (20)
Mabou River	NE Mabou	-61.3889	46.09333	2006	31.34 (21)	40.30 (27)
Mabou River	Mull	-61.3138	46.02867	2006	22.22 (16)	38.89 (28)
Mabou River	Mull	-61.3446	45.97947	2006	32.90 (50)	27.63 (42)
MacInnis BK	Lakevale	-61.91686	45.8086	2006	No*	
MacKenzies River	Pleasant Bay	-60.82869	46.81897	2008	0	0.58 (1)
Magaree River	Magaree	-61.1327	46.09717	2008	22.27 (53)	12.19 (29)
Magaree River	Magaree	-61.1449	46.20000	2008	11.19 (15)	9.70 (13)
Margaree River	Margaree	-60.9191	46.46803	2008	40.35 (69)	22.81 (39)
Margaree River	Margaree	-60.9443	46.43000	2008	28.72 (27)	23.40 (22)
Margaree River	Margaree	-60.9469	46.38000	2008	97.98 (97)	27.27 (27)
Margaree River	Margaree	-61.0334	46.28967	2008	10.35 (9)	6.90 (6)
Mattatall Lake Bk	French River	-63.32794	45.7037	2005	Yes*	
McLellans Bk	East River (Priestville)	-62.65119	45.6269	2008	Yes*	
Mill Bk	Mabou Mines	-61.4488	46.14311	2008	0	0
Mill Bk	Strait of Canso	-61.4219	45.66947	2008	0	22.64 (12)
North River	Antigonish Harbour	-61.9391	45.6661	2008	Yes*	
Pine Tree Bk	New Glasgow	-62.5448	45.60108	2008	0	0
Pomquet River	Pomquet	-61.80641	45.5912	2007	Yes*	
Pugwash River	Britton Brook	-63.71208	45.77739	2008	0	0
Pugwash River	Pugwash	-63.7032	45.7616	2005	Yes*	
Red River	Pleasant Bay	-60.76761	46.84706	2008	0	0
Red River	Pleasant Bay	-60.76653	46.84725	2008	0	0
Red River	Pleasant Bay	-60.76653	46.84725	2006	Yes*	
Rigwash Bk	CB Highlands Park	-60.9528	46.67339	2007	0	0
River John	River John	-63.051	45.7269	2008	Yes*	
River Philip	River Philip	-63.81772	45.597028	2008	59.21 (45)	9.21 (7)
River Philip	River Philip	-63.92783	45.62742	2008	32.23 (68)	10.43 (22)
Russell Bk	Sutherlands River	-62.4882	45.5803	2007	Yes*	
Salmon River	Northern Cape Breton	-60.49356	47.00033	2006	Yes*	
Shinimicas River	Linden	-63.90944	45.86644	2008	0	0.61 (1)
Smiths Bk	Broad Cove	-61.2684	46.26394	2008	0	0
Smiths Bk	Broad Cove	-61.2510	46.26028	2008	0	0
Toney River	Toney River	-62.9025	45.75553	2008	0	0
Toney River	Toney River	-62.9032	45.74642	2008	0	0
Vameys Bk	Lismore	-62.2685	45.70116	2005	Yes*	
Wallace River	Wallace	-63.61933	45.65719	2006	8.29 (17)	13.17 (27)
Wallace River	Wallace	-63.56261	45.65478	2006	74.11 (83)	10.71 (12)
Waughs River	Tatamagouche	-63.2488	45.6935	2007	Yes*	
West River	Antigonish	-62.1333	45.54103	2008	26.36 (29)	18.18 (20)
West River (Pictou)	New Glasgow	-62.8767	45.54413	2007	24.35 (47)	23.83 (46)
Wrights River	Havre Boucher	-61.5175	45.66708	2008	0	4.82 (4)

Yes*: either fry or parr were present. These sites were electro-fished by staff from the regional office in Antigonish; Coordinates are given for the entrance of the river.

Table 12. Estimated number of large salmon returns, smolt age of cohort, and number of smolts produced and smolts produced per salmon in Margaree River for egg deposition years 1999 to 2004.

Year class	Large salmon Returns	Smolt age				*Total Smolts	Smolts per large salmon
		2	3	4	5		
1999	2,300	23,700	46,100	5,500	1,100	76,500	33
2000	2,200	33,500	59,500	8,500	0	101,600	47
2001	2,500	42,600	49,700	5,500	0	97,800	39
2002	1,800	32,300	37,200	3,200		72,700	40
2003	3,600	71,500	53,400			124,900	35
2004	3,900	50,600				50,600	

Blank cell represent no estimates available to date. For instance, the age-3 smolts produced from eggs deposited in fall 2004 will be migrating out of the river in spring 2008.

* Total smolts represent the estimated total number of smolt of a given cohort captured to date (Different than the smolt class estimated in Table 13).

Table 13. Summary of run size, smolt density per juvenile rearing habitat and biological characteristics of wild Atlantic salmon smolt in the Margaree River, 2002 to 2008.

Year	Run size			Smolts per $100m^2$		Size (Mean)			Proportion at freshwater age		
	Estimate	95% Conf. Int.		Estimate	95% Conf. Int.	Length (mm)	Weight (g)	Prop. Females	2	3	4
2001*	.	.	.	.	.	125	18.8	0.70	0.39	0.59	0.02
2002	63,200	34,600	91,800	2.3	1.2 - 3.3	120	19.2	0.74	0.36	0.59	0.05
2003	83,100	69,100	97,000	3.0	2.5 - 3.5	125	20.7	0.76	0.4	0.55	0.05
2004	108,700	94,700	126,500	3.7	3.1 - 4.2	130	25.2	0.75	0.39	0.55	0.06
2005	91,700	79,400	108,200	3.3	2.8 - 3.8	130	24.2	0.72	0.36	0.54	0.09
2006	114,200	100,400	131,900	3.6	3.1 - 4.1	128	21.2	0.72	0.63	0.33	0.05
2007	107,300	91,100	130,100	3.8	3.3 - 4.6	128	20.8	0.73	0.47	0.50	0.03
2008	97,600	85,000	114,100	3.6	3.2 - 4.2	130	23.0	0.72	0.49	0.48	0.03

* Not enough recaptures in 2001 to obtain a smolt estimate.

Table 14. Estimation of the smolt run size, small and large salmon returns and the return rate of small and large salmon based on smolt estimates in Margaree River, 2002 to 2008. Absence of value during 2007 and 2008 is because the adults will be estimated in 2009. Data for 2008 are preliminary.

	2002	2003	2004	2005	2006	2007	2008
Smolt run size estimates	63,200	83,100	108,700	91,700	114,200	107,300	97,600
Small salmon returns (smolt year+1)	560	630	480	480	350	580	
Return rate of small salmon	**0.9%**	**0.8%**	**0.8%**	**0.6%**	**0.3%**	**0.6%**	
Large salmon returns (smolt year+2)	3,900	3,200	3,100	2,200	3,400		
Return rate of large salmon	**6.2%**	**3.9%**	**2.9%**	**2.4%**	**3.0%**		

Table 15. Summary of threats to, and rating of effects on recovery and/ or persistence of Atlantic salmon in SFA 18.

Potential sources of mortality /harm Permitted and un-permitted activities	Source (*with examples*)	Proportion of salmon in SFA 18 affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN	Cause/ Time Frame Historic (H) Current (C) Potential (P)	Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)	Management Alternatives/ Mitigation (*relative to existing actions*)
Directed Salmon Fishing	Aboriginal	**Low**	**H C**	**Low**	Control harvest through agreements between DFO and First Nations
	Recreational: retention & release	**Low**	**H C**	**Low**– 1SW retention only	Encourage the use of catch and release measures
	Commercial (domestic)	**Not Applicable** – all commercial fisheries closed			
	High Seas (West Greenland / St. Pierre – Miquelon)	**Low**	**H C**	**Low**	Reductions in internal use fisheries in those areas
	Illegal (poaching)	**Low**	**H C**	**Low**– increased enforcement in conjunction with DFO and provincial enforcement officers; Initiated stewardship initiatives with local groups; changed enforcement strategies for more targeted efforts	Continued use of compliance monitors on selected watersheds including Aboriginal guardians
	CUMULATIVE EFFECT	**LOW**	**C**	**LOW**– many initiatives in place in recent years	
Bycatch of					

Table 15 (continued). Summary of threats to, and rating of effects on recovery and/ or persistence of Atlantic salmon in SFA 18.

Potential sources of mortality /harm Permitted and un-permitted activities	Source (*with examples*)	Proportion of salmon in SFA 18 affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN	Cause/ Time Frame Historic (H) Current (C) Potential (P)	Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)	Management Alternatives/ Mitigation *(relative to existing actions)*
Bycatch of Salmon in Fisheries for Other Species	Aboriginal	**Low**	**C**	**Low–** all by catch mandatory release	
	Recreational	**Low**	**C**	**Low–** all by catch mandatory release	
	Commercial near shore	**Low**		**Low–** all by catch mandatory release	
	Commercial distant	**Low**			None apparent
	CUMULATIVE EFFECT	**LOW**	**C**	**LOW**	None apparent
Salmon Fisheries Impacts on Salmon Habitat	Aboriginal	**Low**	**H C**	**Low**	None apparent
	Recreational	**Low**	**H C**	**Low**	None apparent
	Commercial	**Not Applicable**			
	Illegal	**Low**	**H C**	**Low**	None apparent
	CUMULATIVE EFFECT	**LOW**		**LOW**	None apparent
Mortality Associated with Water Use	Power generation at dams & tidal facilities (turbine mortality, entrainment, stranding)	**Not Applicable**			

Potential sources of mortality /harm Permitted and un-permitted activities	Source (*with examples*)	Proportion of salmon in SFA 18 affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN	Cause/ Time Frame Historic (H) Current (C) Potential (P)	Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)	Management Alternatives/ Mitigation *(relative to existing actions)*
Habitat Alterations	Municipal waste water treatment facilities	**Low – Medium**	**H C P**	**Low – Medium**– some inadequate facilities and occasional system failures	Ensure current projects and future developments meet standards.
	Pulp & paper mills	**Low**	**H C P**	**Low** – pulp and paper mills comply with pulp and paper effluent regulations	.
Habitat alterations	Hydroelectric power generation (dams & reservoirs, tidal power): altered behavior & ecosystems	**Low**			None apparent
	Thermal generation station (entrapment, entrainment, temperature effects)	**Low**		**Low**– mitigation measures in place	
	Water extractions	**Low**	**H C P**	**Low**	Must meet regulations in place; monitoring; develop regional guidelines
	Urbanization (altered hydrology)	**Low**	**H C P**	**Low**	Project redesign; existing regulation - monitoring
	Infrastructure (roads/culverts) (fish passage)	**Medium**	**H C P**	**Medium**– many non compliant culverts	Existing regulations; more monitoring/ enforcement
	Aquaculture siting	**Not Applicable**			
	Agriculture / Forestry / Mining, etc.	**Low**	**H C P**	**Low**	Enforcement/ monitoring of existing suite of regulations; compensations where required

Table 15 (continued). Summary of threats to, and rating of effects on recovery and/ or persistence of Atlantic salmon in SFA 18.

Potential sources of mortality /harm Permitted and un-permitted activities	Source (*with examples*)	Proportion of salmon in SFA 18 affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN	Cause/ Time Frame Historic (H) Current (C) Potential (P)	Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)	Management Alternatives/ Mitigation *(relative to existing actions)*
Habitat alterations	Hydroelectric power generation (dams & reservoirs, tidal power): altered behavior & ecosystems Thermal generation station (entrapment, entrainment, temperature effects)	**Low** **Low**		**Low–** mitigation measures in place	None apparent
	Water extractions	**Low**	**H C P**	**Low**	Must meet regulations in place; monitoring; develop regional guidelines
	Urbanization (altered hydrology)	**Low**	**H C P**	**Low**	Project redesign; existing regulation - monitoring
	Infrastructure (roads/culverts) (fish passage)	**Medium**	**H C P**	**Medium–** many non compliant culverts	Existing regulations; more monitoring/ enforcement
	Aquaculture siting	**Not Applicable**			
	Agriculture / Forestry / Mining, etc.	**Low**	**H C P**	**Low**	Enforcement/ monitoring of existing suite of regulations; compensations where required

Table 15 (continued). Summary of threats to, and rating of effects on recovery and/ or persistence of Atlantic salmon in SFA 18.

Potential sources of mortality /harm Permitted and un-permitted activities	Source (*with examples*)	Proportion of salmon in SFA 18 affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN	Cause/ Time Frame Historic (H) Current (C) Potential (P)	Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)	Management Alternatives/ Mitigation (*relative to existing actions*)
Habitat alteration	Municipal, provincial & federal dredging	**Low**	**H C P**	**Low**	Follow regulations in place; mitigations and compensations as required; minimize amount
	CUMULATIVE EFFECT	**MEDIUM**		**MEDIUM**	None apparent
Shipping, Transport and Noise	Municipal, provincial, federal & private transport activities (inc. land and water based contaminants/ spills)	**Uncertain**	**H C P**	**Uncertain**	None apparent
Fisheries on Prey of Salmon (for ex. capelin, smelt, shrimp)	Commercial, Recreational, Aboriginal fisheries for species a, b, c etc.	**Uncertain**	**H C P**	**Uncertain**	None apparent
Aquaculture (Salmon and other species)	Escapes from fresh water, marine facilities, disease, parasites, competition, effects on behaviour and migration, genetic introgression	**Low**	**H C P**	**Low**	Fish health regulations; introduction and transfer regulation
Fish culture / stocking (non-commercial, including private, NGO, government)	Impacts on effective population size, over representation of families, domestication	**Low**	**H C P**	**Low**	None apparent
Scientific Research	Government, university, community and Aboriginal groups	**Low**	**C**	**Low** – minimal removal for scientific purpose	None apparent

Table 16. List of man-made barriers present in rivers of SFA 18 during 2008.

Location / Structure	River	Impounded portion	Longitude (W)	Latitude (N)
Wallace Bay	Dyke or levee across small embayment	No detectable streams upriver	-63.55040	45.82710
Water supply, Malagash Mine	Unnamed brook	0.8 of 2 km length	-63.32890	45.79060
Mill Bk. (Central Caribou)	Mill Brook	4.9 of 5.3 km length	-62.73260	45.72220
Haliburton Brook near Pictou	Haliburton Brook	10 of 10.2 km length	-62.73630	45.68590
Bay in Middle River (Pictou) – Middle River Reservoir	Middle River	Entire length	-62.74480	45.64170
Lowden Brook at Trenton	Lowden Brook	1.4 of 2.5 km length	-62.62771	45.62350
Brierly Bk.	Brierly Bk.	17.9 of 21.6 km length	-62.02020	45.61444
Rights River	Willies Bk.	3.7 of 18.6 km length	-62.04531	45.63710
South River (2 barriers)	South River	30 of 46.6 km length	-61.93823	45.49129
	South River		-61.93730	45.43110
Tracadie River (4 barriers)	East Branch Tracadie River	14.6 of 22.8 km length	-61.54875	45.59419
	East Branch Tracadie River		-61.51415	45.59086
	East Branch Tracadie River		-61.50097	45.61066
	East Branch Tracadie River		-61.50121	45.60612
	East Branch Tracadie River		-61.48490	45.60189
Barrys River (4 barriers)	Barrys River	6.8 of 8.3 km length	-61.45226	45.61657
	Barrys River		-61.44231	45.63323
	Barrys River		-61.44090	45.63399
	Unnamed brook		-61.43730	45.63440

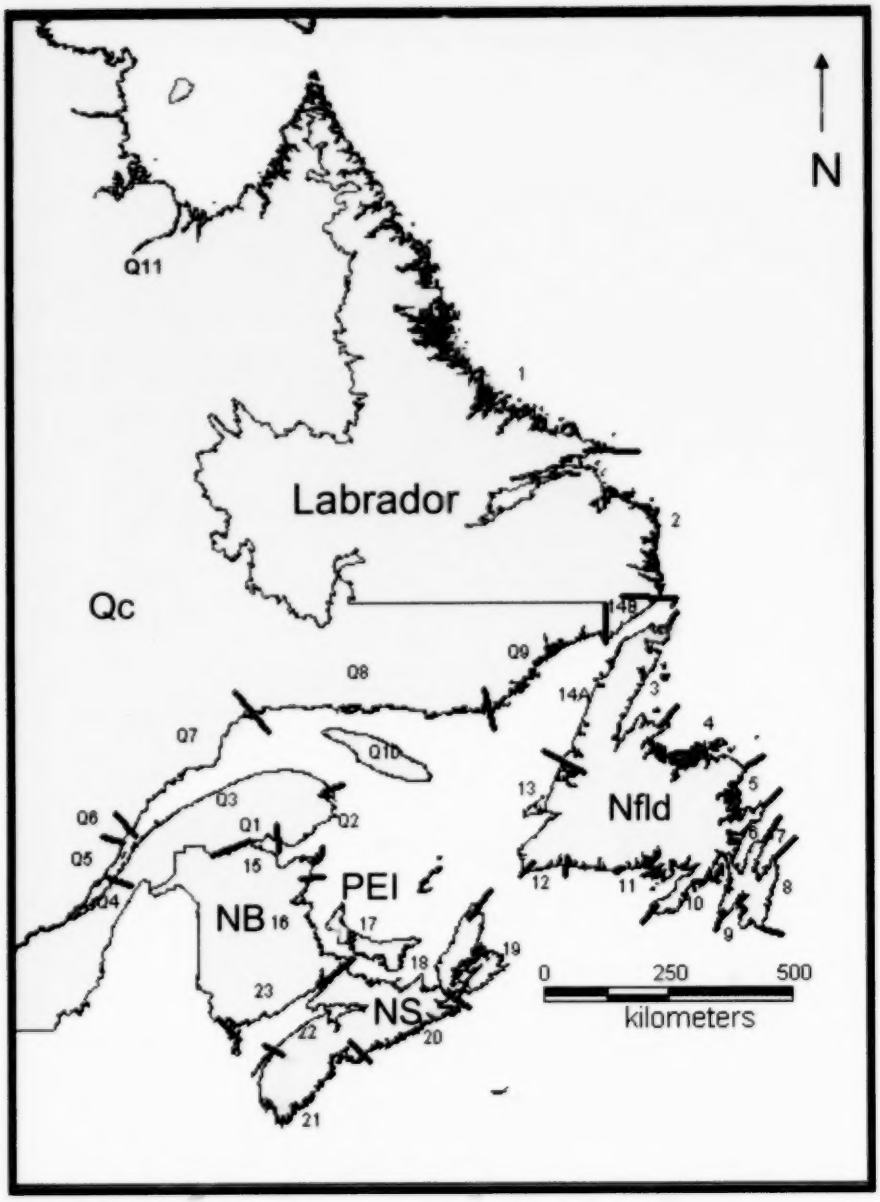

Figure 1. Salmon Fishing Areas in eastern Canada.

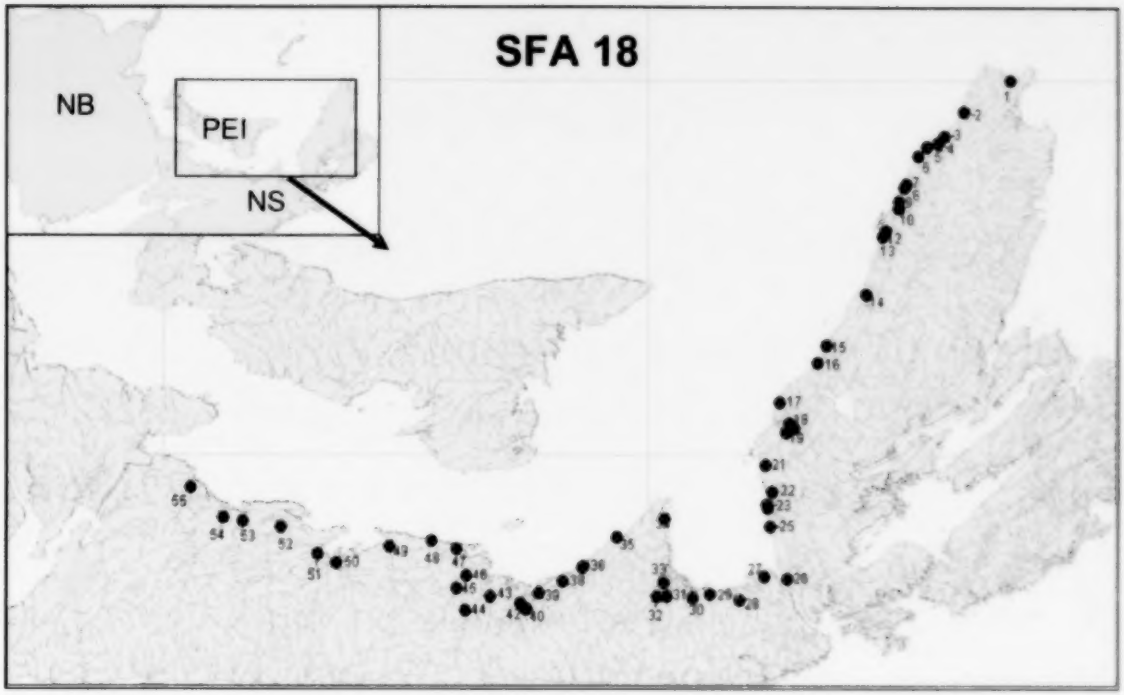

Figure 2. Potential Altantic salmon rivers in Gulf Nova Scotia (Salmon Fishing Area 18). Numbers refer to numbered rivers in Table 1. Numbering is sequential and the following numbers are omitted for clarity: 11, 20, 24, 37 and 41.

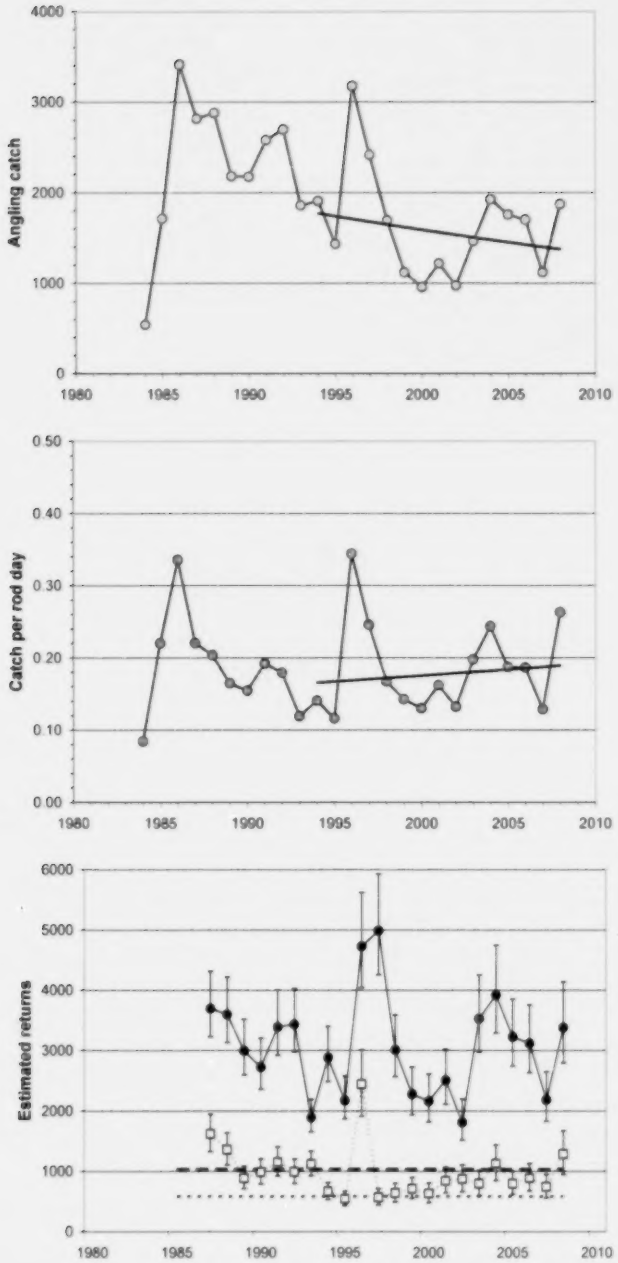

Figure 3. Catch of salmon (size groups combined, upper), catch per rod day (middle) and estimated returns (lower) of small (open square) and large salmon (solid circle) to the Margaree River, 1984 to 2008. The conservation requirement is depicted with a long dash line for large salmon and a short dash line for small salmon (O'Connell et al. 1997). Vertical bars represent the 2.5% and the 97.5% confidence intervals.

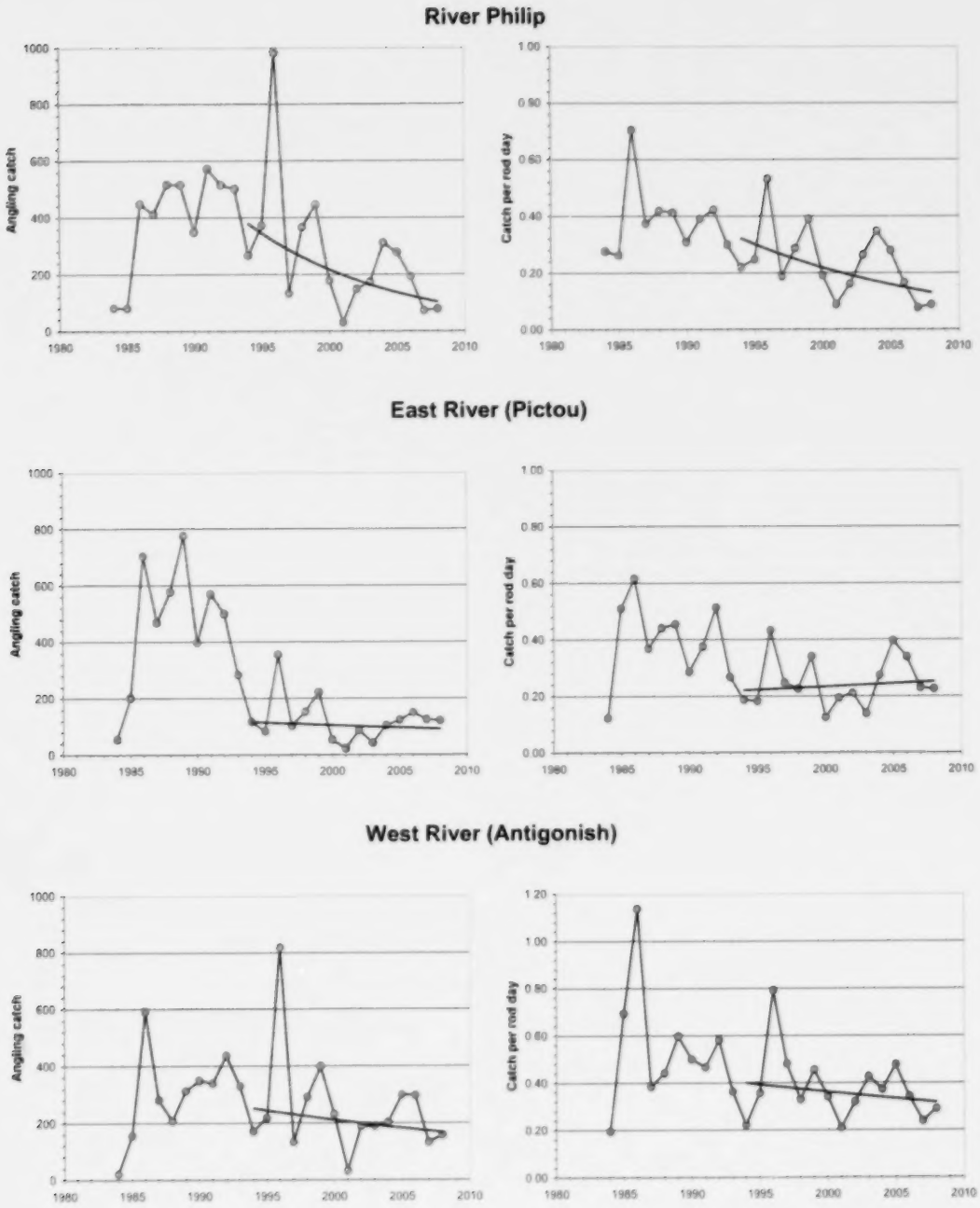

Figure 4. Angling catch of small salmon and large salmon combined (left panels) and catch per rod day (right panels) for rivers from the mainland portion of SFA 18, 1984 to 2008.

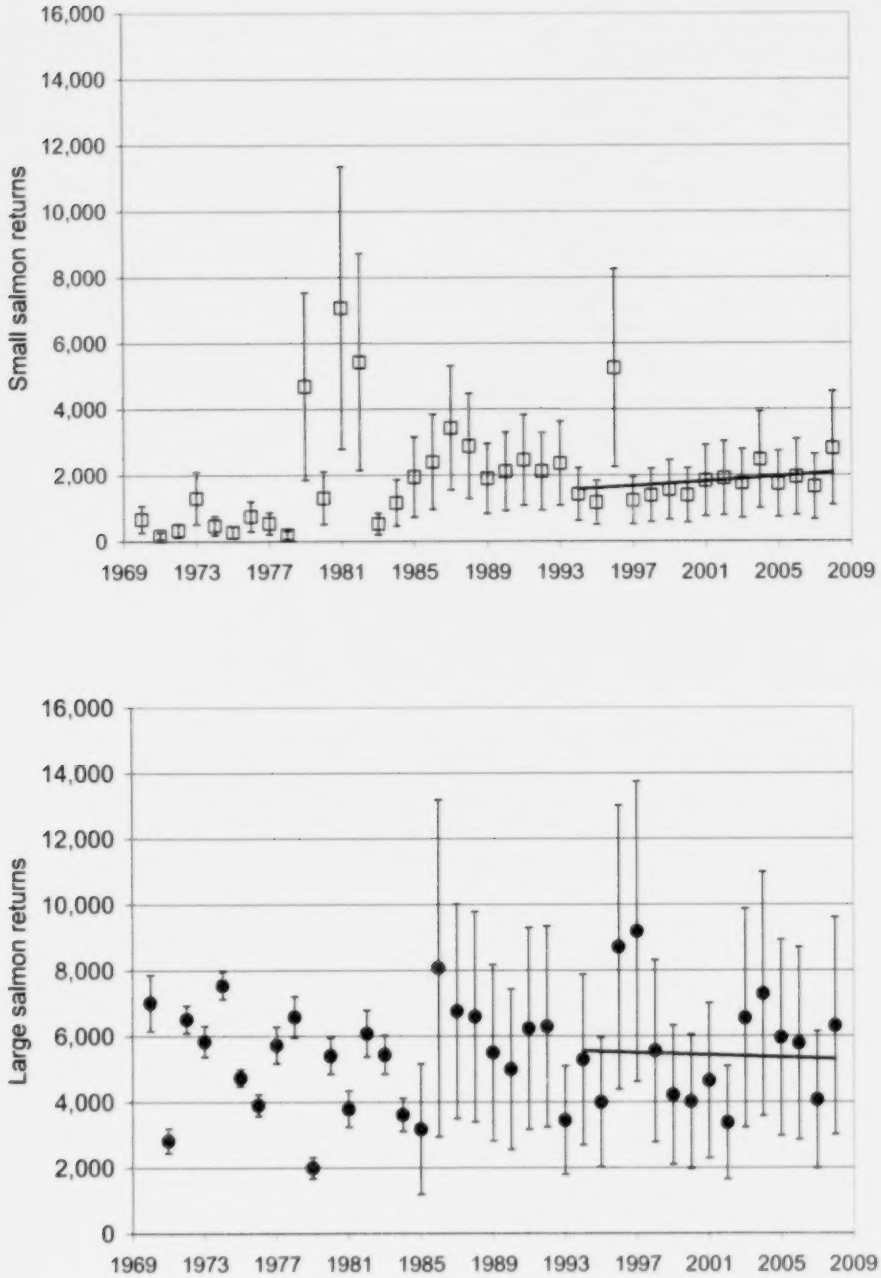

Figure 5. The estimation range (minimum and maximum) of small salmon (upper panel) and large salmon (lower panel) returns in SFA 18, 1970 to 2008. Vertical bars represent the 2.5% and the 97.5% confidence intervals.

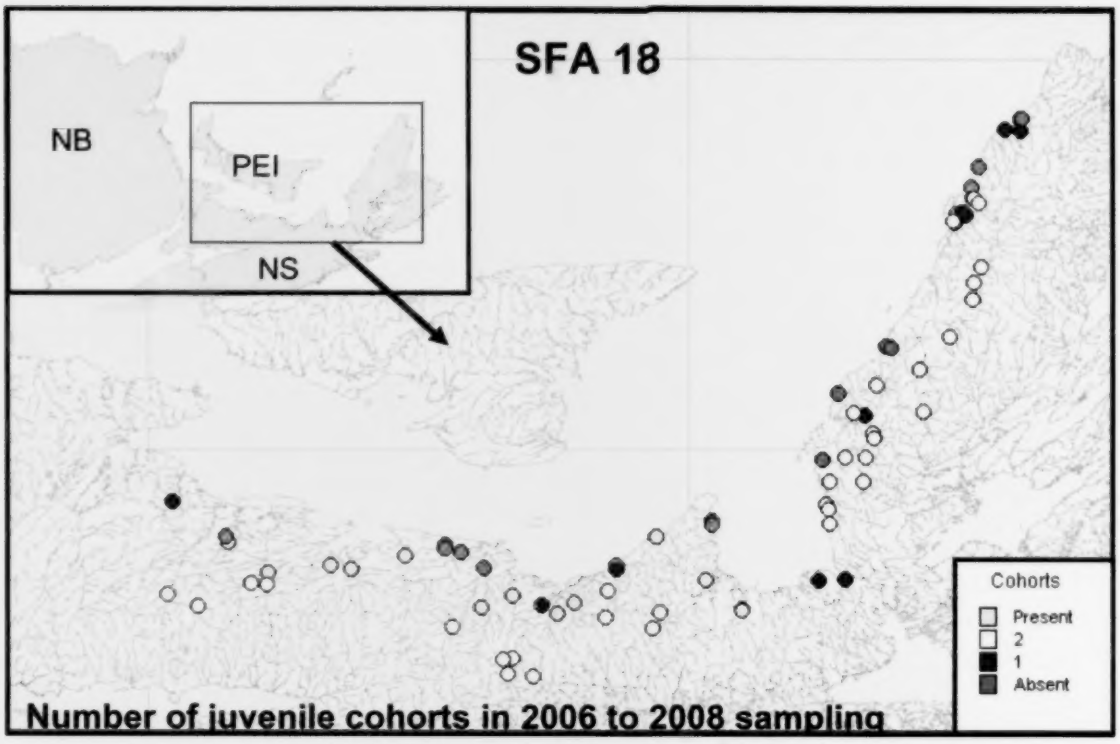

Figure 6. Presence of juvenile Atlantic salmon in rivers of SFA 18 (Northumberland Strait Nova Scotia and Cape Breton Island). Symbols indicate the following: present represents presence of juvenile salmon (age class unknown), 2: fry and parr present, 1: fry or parr present and absent: no juvenile salmon found. Note: present and a number of absent symbols represent sites electrofished by the Habitat Branch (Charles MacInnis, DFO).

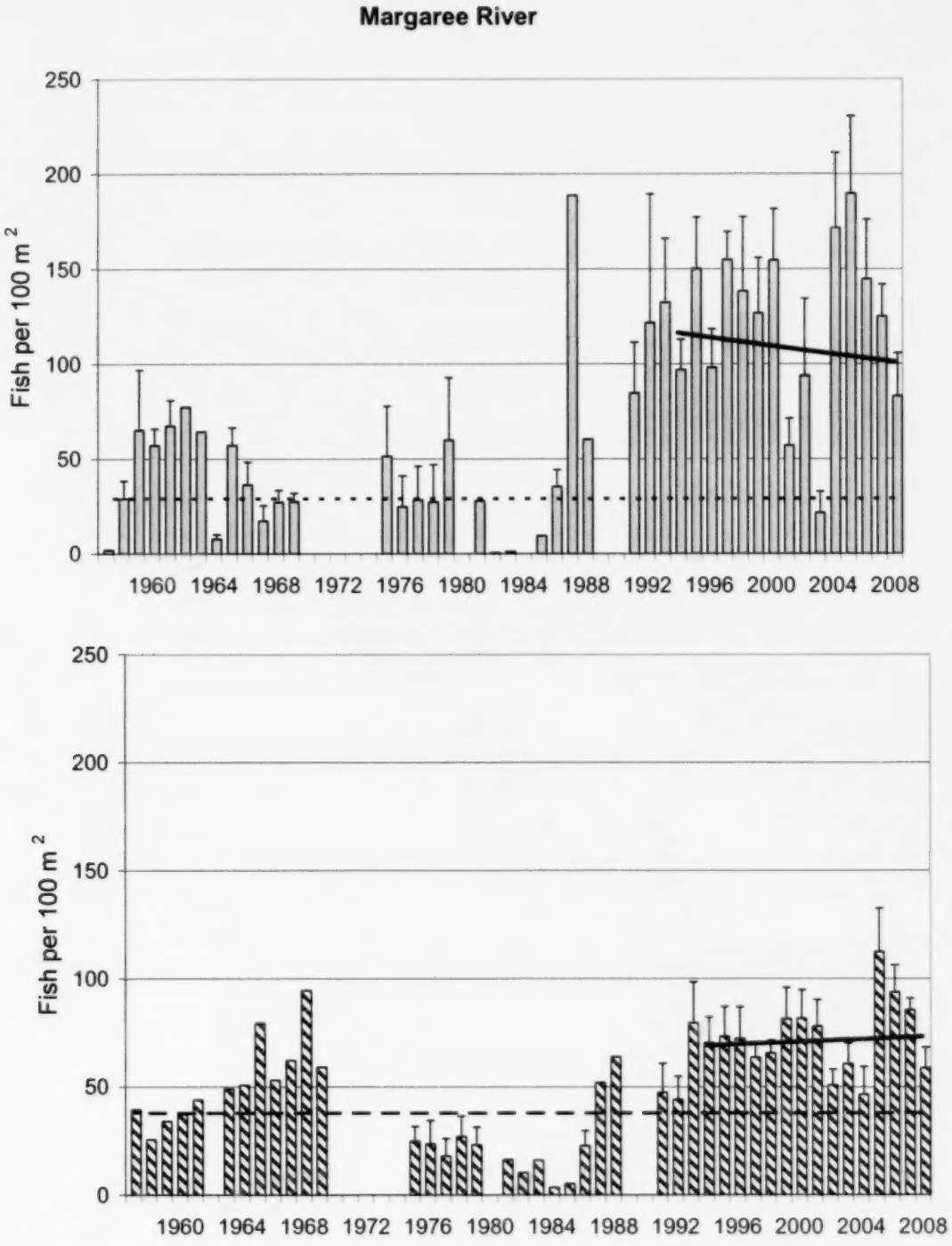

Figure 7. Density of fry (upper panel) and parr (lower panel) per $100m^2$ in the Margaree River over the period of 1957 to 2008. Elson norms of 38 fry/$100m^2$ and 29 parr/$100m^2$ are depicted by the dashed lines. Note: y-axis different between figures.

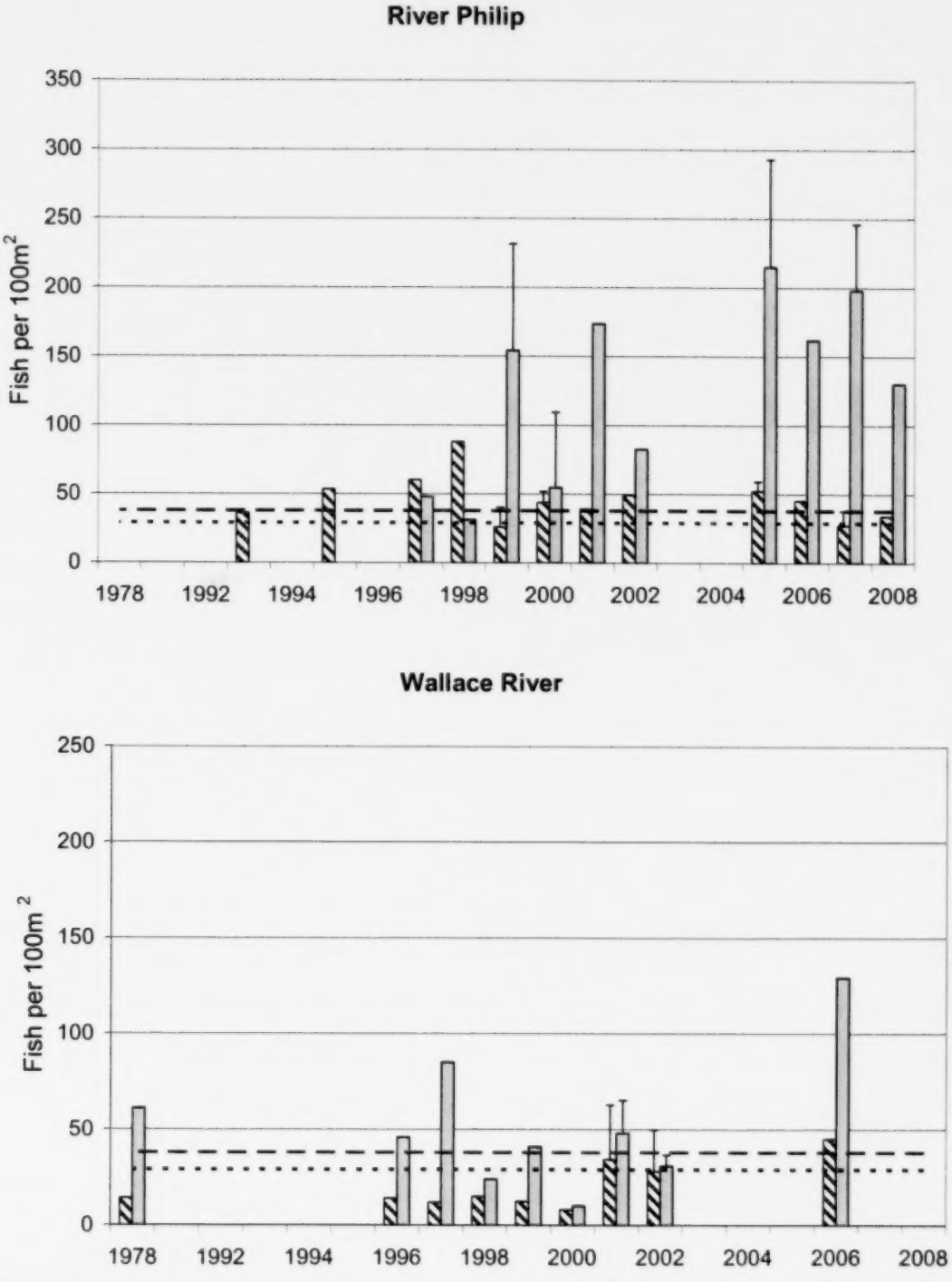

Figure 8. Density of fry (grey bar) and parr (dashed bar) per $100m^2$ in River Philip (upper panel) and Wallace River (lower panel) over the period of 1978 to 2008. Elson norms of 38 fry/$100m^2$ (short dash line) and 29 parr/$100m^2$ (long dash line) are depicted. Note: y-axis different between figures.

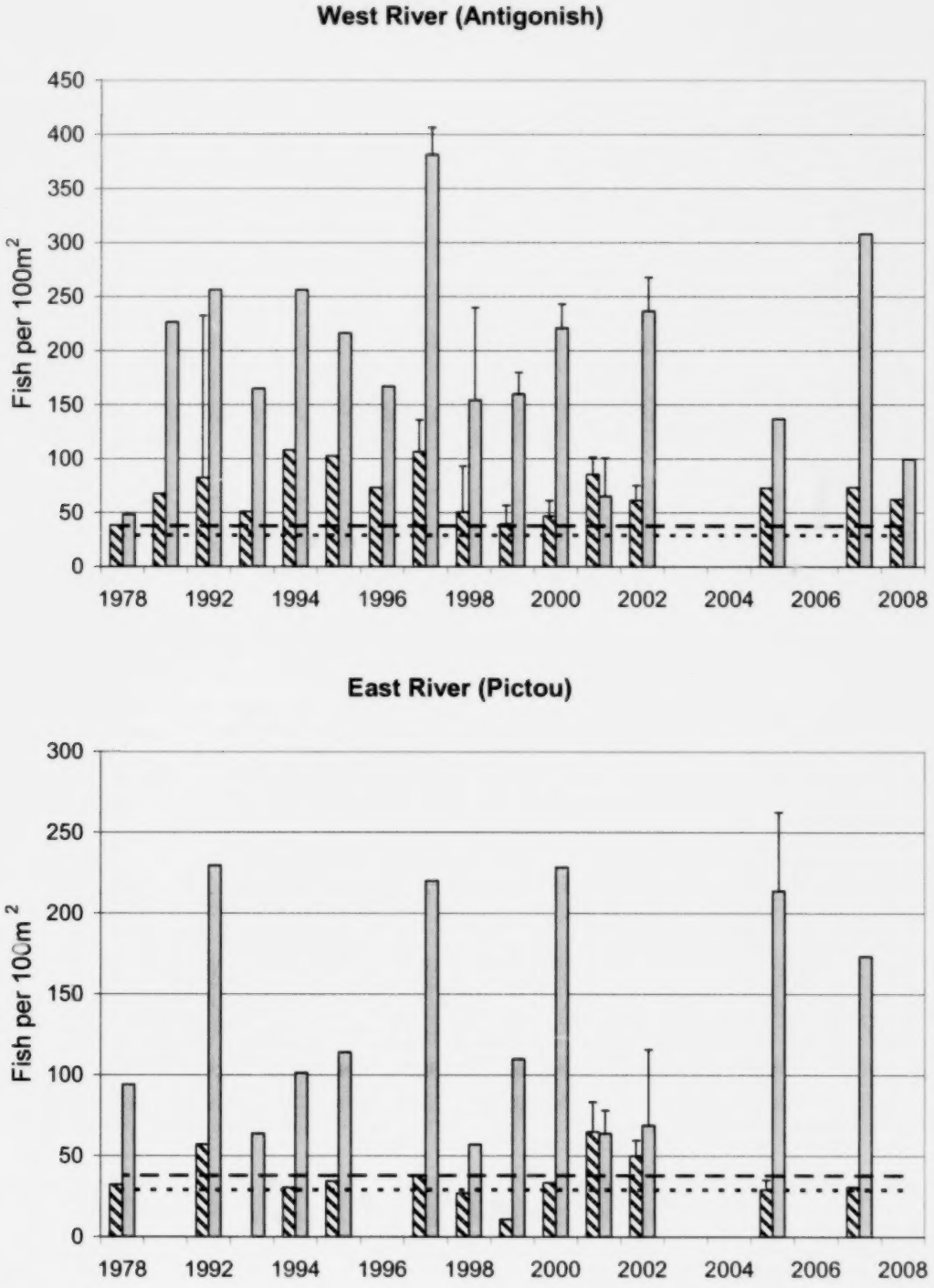

Figure 9. Density of fry (grey bar) and parr (dashed bar) per $100m^2$ in West River Antigonish (upper panel) and East River Pictou (lower panel) over the period of 1978 to 2008. Elson norms of 38 fry/$100m^2$ (short dash line) and 29 parr/$100m^2$ (long dash line) are depicted. Note: y-axis different between figures.

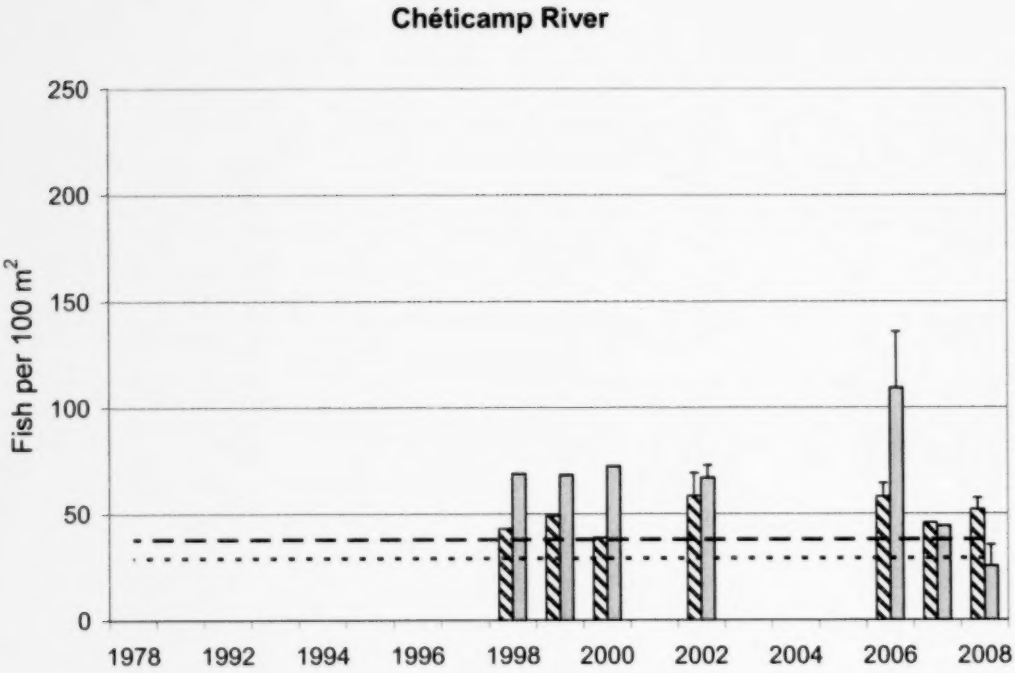

Figure 10. Density of fry (grey bar) and parr (dashed bar) per $100m^2$ in Chéticamp River over the period of 1978 to 2008. Elson norms of 38 fry/$100m^2$ (short dash line) and 29 parr/$100m^2$ (long dash line) are depicted. Note: y-axis different between figures.

Appendix 1. Angling effort and catch of Atlantic salmon from the Margaree River and for SFA 18, 1984 to 2008. Effort, small salmon kept, small salmon released, large salmon released, and catch per unit effort for large salmon catch (catch per rod day) are shown specifically for Margaree River.

River	Margaree River					Percent small salmon released	SFA 18			Margaree as percent of SFA 18		
Year	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE		Effort (rod days)	Small salmon catch	Large salmon catch	Effort	Small salmon catch	Large salmon catch
1984	6,410	196	246	296	0.046	20%	7,496	308	438	86%	80%	68%
1985	7,775	399	508	1,206	0.155	21%	9,077	619	1,693	86%	82%	71%
1986	10,172	651	783	2,632	0.259	17%	13,120	1,179	4,429	78%	66%	59%
1987	12,773	822	972	1,847	0.145	15%	16,902	1,283	2,998	76%	76%	62%
1988	14,136	771	901	1,979	0.140	14%	18,272	1,389	3,184	77%	65%	62%
1989	13,241	444	574	1,607	0.121	23%	18,093	945	3,267	73%	61%	49%
1990	14,062	502	655	1,520	0.108	23%	18,418	1,217	2,409	76%	54%	63%
1991	13,407	575	773	1,808	0.135	26%	19,028	1,278	3,505	70%	60%	52%
1992	15,016	568	699	1,999	0.133	19%	19,482	1,291	3,447	77%	54%	58%
1993	15,575	556	769	1,090	0.070	28%	21,468	1,214	2,367	73%	63%	46%
1994	13,534	290	427	1,478	0.109	32%	17,440	656	2,037	78%	65%	73%
1995	12,336	205	343	1,091	0.088	40%	16,528	718	1,656	75%	48%	66%
1996	9,224	284	1,239	1,938	0.210	77%	15,207	2,116	4,106	61%	59%	47%
1997	9,827	195	311	2,105	0.214	37%	12,325	545	2,585	80%	57%	81%
1998	10,129	209	352	1,341	0.132	41%	14,593	814	2,152	69%	43%	62%
1999	7,843	197	311	808	0.103	37%	12,101	844	1,877	65%	37%	43%
2000	7,351	133	262	696	0.095	49%	10,646	551	1,087	69%	48%	64%
2001	7,521	142	364	854	0.114	61%	8,579	419	921	88%	87%	93%
2002	7,359	161	363	611	0.083	56%	10,644	707	908	69%	51%	67%
2003	7,398	184	327	1,138	0.154	44%	9,898	540	1,562	75%	61%	73%
2004	7,896	251	518	1,408	0.178	52%	10,853	931	1,977	73%	56%	71%
2005	9,382	206	418	1,340	0.143	51%	12,743	873	2,079	74%	48%	64%
2006	9,088	253	444	1,256	0.138	43%	12,863	739	1,905	71%	60%	66%
2007	8,675	186	337	785	0.088	45%	11,771	633	1,059	74%	53%	74%
2008	7,109	299	614	1,258	0.180	51%	10,656	995	1,703	67%	62%	74%

Appendix 2. Angling catch data for Shinimicas River, River Philip and Wallace River, three rivers of Cumberland County, 1984 to 2008. Small salmon catch includes small salmon kept and small salmon released. Catch per unit effort (CPUE) is the sum of small salmon catch and large salmon released divided by effort. No angling activity reported in years with empty cells. Data for 2008 are preliminary.

River	Shinimicas River					River Philip					Wallace River				
Year	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE
1984						297	23	25	57	0.28	52	1	1	4	0.10
1985	2	0	0	0	0.00	309	11	12	69	0.26	85	3	5	16	0.25
1986						636	87	111	337	0.70	232	15	16	115	0.57
1987	4	0	2	1	0.75	1,108	66	76	338	0.37	282	9	11	49	0.21
1988						1,235	154	176	342	0.42	297	14	17	35	0.18
1989	4	0	0	0	0.00	1,249	93	113	403	0.41	239	10	13	34	0.20
1990						1,137	126	157	193	0.32	258	11	16	33	0.19
1991						1,469	107	161	412	0.39	399	25	39	88	0.32
1992						1,221	169	184	332	0.42	428	19	31	91	0.29
1993						1,677	107	166	336	0.30	847	20	33	109	0.17
1994						1,210	62	88	179	0.22	487	11	22	56	0.16
1995	1	0	0	0	0.00	1,506	105	138	234	0.25	617	19	32	30	0.10
1996						1,845	181	260	722	0.53	453	21	27	93	0.27
1997						713	38	43	90	0.19	389	13	39	105	0.37
1998						1,282	86	119	248	0.29	358	29	41	60	0.28
1999						1,142	101	146	300	0.39	343	11	23	67	0.26
2000	1	0	0	0	0.00	936	41	63	115	0.19	297	12	22	22	0.15
2001	1	0	0	0	0.00	340	4	13	17	0.09	141	3	7	4	0.08
2002	16	1	1	0	0.06	922	42	89	59	0.16	336	15	29	25	0.16
2003						661	45	86	88	0.26	340	10	15	31	0.14
2004						896	62	145	166	0.35	345	26	46	63	0.32
2005						998	45	111	167	0.28	300	5	36	47	0.28
2006						1,164	29	54	138	0.17	468	11	29	70	0.21
2007	1	0	0	0	0.00	948	12	40	33	0.08	333	4	5	12	0.05
2008						901	14	45	34	0.09	313	11	20	25	0.09

Appendix 3. Angling catch data for River John, East River and Middle River, three rivers of Pictou County, 1984 to 2008. Small salmon catch includes small salmon kept and small salmon released. Catch per unit effort (CPUE) is the sum of small salmon catch and large salmon released divided by effort. No angling activity reported in years with empty cells. Data for 2008 are preliminary.

River	River John					East River (Pictou)					Middle River (Pictou)				
Year	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE
1984	22	1	1	0	0.05	455	13	15	41	0.12					
1985	58	1	2	58	1.03	396	25	41	161	0.51	1	0	0	0	0
1986	187	29	30	152	0.97	1,144	71	89	616	0.62					
1987	235	21	24	70	0.40	1,275	63	82	388	0.37	2	0	0	3	1.50
1988	258	40	53	121	0.67	1,309	100	135	443	0.44					
1989	267	17	18	99	0.44	1,706	42	89	687	0.46					
1990	302	52	66	44	0.36	1,393	81	106	292	0.29					
1991	200	28	34	81	0.58	1,522	77	123	448	0.38	4	0	0	1	0.25
1992	167	11	17	77	0.56	974	64	115	386	0.51					
1993	234	14	22	73	0.41	1,063	35	57	227	0.27	2	0	1	0	0.50
1994	185	11	13	34	0.25	627	15	24	93	0.19					
1995	122	10	12	17	0.24	460	21	37	47	0.18					
1996	276	21	33	118	0.55	819	34	75	280	0.43					
1997	210	23	24	52	0.36	417	24	36	67	0.25					
1998	209	19	44	37	0.39	678	25	47	106	0.23	5	0	0	0	0
1999	231	17	23	56	0.34	652	24	54	168	0.34	3	0	0	0	0
2000	169	6	8	10	0.11	433	11	25	29	0.13					
2001	25	0	0	0	0	119	8	12	11	0.19					
2002	104	5	8	5	0.13	414	5	31	56	0.21	3	0	2	0	0.67
2003	70	0	0	0	0	312	4	14	29	0.14	6	0	0	0	0
2004	151	19	26	34	0.40	384	17	38	67	0.27					
2005	126	11	21	87	0.86	313	24	57	67	0.40	1	0	0	0	0
2006	95	5	8	18	0.27	443	10	29	121	0.34	5	0	0	0	0
2007	112	7	19	23	0.38	542	18	54	68	0.23					
2008	98	9	27	18	0.46	389	13	60	101	0.41	2	0	0	0	0

Appendix 4. Angling catch data for West River, South River and Pomquet River, three rivers of Antigonish County, 1984 to 2008. Small salmon catch includes small salmon kept and small salmon released. Catch per unit effort (CPUE) is the sum of small salmon catch and large salmon released divided by effort. No angling activity reported in years with empty cells. Data for 2008 are preliminary.

River	West River					South River					Pomquet River				
Year	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE
1984	103	16	18	2	0.19	3	0	0	0	0	2	0	0	0	0
1985	224	25	34	121	0.69	7	0	0	0	0	1	0	0	0	0
1986	521	84	124	468	1.14	14	2	4	5	0.64	6	1	1	2	0.50
1987	734	58	84	197	0.38	15	0	0	1	0.07	38	3	5	3	0.21
1988	472	36	68	140	0.44	31	1	1	0	0.03	1	0	0	0	0
1989	525	67	91	222	0.60	32	6	12	1	0.41	5	1	1	1	0.40
1990	698	88	150	198	0.50	18	4	4	7	0.61					
1991	731	38	63	277	0.47	44	1	1	8	0.21	3	0	0	0	0
1992	753	80	144	293	0.58	30	3	11	6	0.57					
1993	911	40	69	261	0.36	63	9	14	8	0.35	4	0	0	0	0
1994	769	29	43	127	0.22	79	4	9	10	0.24					
1995	612	48	81	137	0.36	65	1	4	0	0.06					
1996	1,034	118	305	513	0.79	109	10	25	24	0.45					
1997	277	22	43	90	0.48	27	1	1	3	0.15	15	0	0	0	0
1998	885	58	123	168	0.33	85	4	11	9	0.24	45	0	1	4	0.11
1999	879	78	167	232	0.45	104	10	23	28	0.49	27	1	5	6	0.41
2000	678	32	97	134	0.34	125	4	19	27	0.37	24	0	1	5	0.25
2001	153	0	12	20	0.21	16	0	0	0	0	4	0	0	0	0
2002	591	32	107	81	0.32	62	1	3	3	0.10	41	0	16	8	0.56
2003	444	16	53	136	0.43	70	0	6	35	0.59	51	0	2	4	0.12
2004	549	26	79	125	0.37	73	3	7	22	0.40	13	0	0	5	0.39
2005	629	17	105	194	0.48	165	10	33	21	0.33	109	4	25	12	0.34
2006	870	22	118	179	0.34	59	1	2	4	0.10	35	1	2	9	0.31
2007	542	19	102	55	0.23	49	0	5	10	0.31	21	0	8	3	0.52
2008	497	9	56	60	0.12	51	2	24	7	0.61	7	0	7	7	2

Appendix 5. Angling catch data for French River and Waughs River, two rivers of Colchester County, 1984 to 2008. Small salmon catch includes small salmon kept and small salmon released. Catch per unit effort (CPUE) is the sum of small salmon catch and large salmon released divided by effort. No angling activity reported in years with empty cells. Data for 2008 are preliminary.

River	French River					Waughs River				
Year	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE
1984						8	0	0	0	0
1985						5	0	0	1	0.20
1986	7	0	0	0	0	33	6	9	28	1.12
1987	2	0	0	0	0	47	0	0	7	0.15
1988	6	0	0	2	0.33	74	5	11	26	0.50
1989	1	0	0	0	0	92	5	5	5	0.11
1990	13	0	1	1	0.15	98	14	15	15	0.31
1991	26	7	8	7	0.58	270	14	19	108	0.47
1992	17	0	0	0	0	123	10	13	18	0.25
1993	23	0	0	7	0.30	201	13	19	42	0.30
1994	22	0	0	0	0	102	6	15	30	0.44
1995	17	1	1	1	0.12	218	13	21	36	0.26
1996	39	1	1	14	0.38	450	25	29	141	0.38
1997	21	3	6	6	0.57	127	7	13	11	0.19
1998	20	1	1	1	0.10	254	15	28	45	0.29
1999	6	2	2	2	0.67	153	10	16	26	0.28
2000	4	0	0	0	0	163	11	13	8	0.13
2001						76	0	2	0	0.03
2002	3	0	0	0	0	146	7	10	7	0.12
2003	4	0	0	0	0	152	2	2	20	0.15
2004	9	0	2	2	0.44	149	3	15	41	0.38
2005	5	0	0	1	0.20	160	3	7	30	0.23
2006	8	0	0	8	1	112	1	2	7	0.08
2007	27	0	3	3	0.22	144	2	12	20	0.22
2008	20	2	4	7	0.55	150	0	11	29	0.27

Appendix 6. Angling catch data for Campbell's Brook and the Mabou River, two streams of Inverness County, 1984 to 2008. Small salmon catch includes small salmon kept and small salmon released. Catch per unit effort (CPUE) is the sum of small salmon catch and large salmon released divided by effort. No angling activity reported in years with empty cells. Data for 2008 are preliminary.

River	Campbell's Brook					Mabou				
Year	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE
1984						1	0	0	0	0
1985										
1986						13	3	3	19	1.69
1987						1	0	0	0	0
1988						5	0	0	0	0
1989										
1990						16	0	0	0	0
1991						9	3	3	3	0.67
1992	27	2	2	7	0.33	26	3	10	23	1.27
1993	29	0	1	10	0.38	12	2	2	3	0.42
1994						31	3	3	1	0.13
1995						8	2	3	1	0.50
1996						21	6	7	6	0.62
1997						11	0	0	2	0.18
1998						20	3	3	5	0.40
1999	1	0	1	0	1	16	3	3	4	0.44
2000						16	4	8	6	0.88
2001						20	4	4	3	0.35
2002	5	0	0	0	0	13	2	2	6	0.62
2003						18	3	3	4	0.39
2004						11	2	3	2	0.46
2005	7	0	1	4	0.71	26	9	12	16	1.08
2006	2	0	0	0	0	27	5	10	9	0.70
2007						39	1	2	1	0.08
2008						13	0	2	0	0.15

Appendix 7. Angling catch data for West River and Sutherlands River, two rivers of Pictou County, 1984 to 2008. Small salmon catch includes small salmon kept and small salmon released. Catch per unit effort (CPUE) is the sum of small salmon catch and large salmon released divided by effort. No angling activity reported in years with empty cells. Data for 2008 are preliminary.

River	West River (Pictou)					Sutherlands River				
Year	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE
1984	1	0	0	0	0.00					
1985	31	2	2	4	0.19	3	0	0	4	1.33
1986	38	3	4	4	0.21	2	0	0	0	0
1987	245	15	15	26	0.17	6	2	4	7	1.83
1988	314	23	25	43	0.22					
1989	425	13	15	61	0.18					
1990	251	32	38	42	0.32					
1991	640	35	45	152	0.31	3	0	0	0	0
1992	415	25	32	129	0.39	9	2	2	1	0.33
1993	608	32	42	168	0.35	25	0	0	0	0
1994	249	3	5	17	0.09					
1995	466	27	37	39	0.16	3	1	1	0	0.33
1996	767	57	87	193	0.37	3	0	0	0	0
1997	205	5	9	27	0.18					
1998	518	30	36	102	0.27	9	0	1	0	0.11
1999	591	28	64	168	0.39					
2000	398	16	26	32	0.15	6	0	0	0	0
2001	122	0	0	7	0.06					
2002	558	19	40	37	0.14	4	0	0	0	0
2003	280	5	15	48	0.23	1	0	0	0	0
2004	342	24	50	31	0.24	2	0	0	0	0
2005	427	13	34	69	0.24	9	1	3	1	0.44
2006	400	22	34	56	0.23	3	0	2	0	0.67
2007	295	16	24	22	0.16	7	0	1	1	0.29
2008	300	16	36	25	0.20					

Appendix 8. Angling catch data for French River and Barneys River, two rivers of Pictou County, 1984 to 2008. Small salmon catch includes small salmon kept and small salmon released. Catch per unit effort (CPUE) is the sum of small salmon catch and large salmon released divided by effort. No angling activity reported in years with empty cells. Data for 2008 are preliminary.

River	French River					Barneys River				
Year	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort (rod days)	Small salmon kept	Small salmon catch	Large salmon released	CPUE
1984										
1985										
1986										
1987										
1988						6	1	1	8	1.50
1989						11	1	6	1	0.64
1990						23	7	7	5	0.52
1991						18	1	1	4	0.28
1992						102	7	11	11	0.22
1993						26	1	1	1	0.08
1994						53	0	0	3	0.06
1995						5	1	1	0	0.20
1996	9	1	1	9	1.11	30	11	14	10	0.80
1997	5	1	1	1	0.40	9	0	0	0	0
1998	4	0	0	0	0	21	0	0	1	0.05
1999	0	0	0	0		11	0	0	4	0.36
2000	0	0	0	0		4	0	0	0	0
2001	0	0	0	0						
2002	0	0	0	0		3	0	0	0	0
2003	0	0	0	0		3	0	0	0	0
2004	0	0	0	0						
2005	0	0	0	0		13	0	1	4	0.39
2006	9	0	0	0	0	8	0	0	2	0.25
2007						7	1	1	1	0.29
2008						9	0	0	0	0

Appendix 9. Angling catch data for Tracadie River and Wright River, two rivers of Antigonish County, 1984 to 2008. Small salmon catch includes small salmon kept and small salmon released. Catch per unit effort (CPUE) is the sum of small salmon catch and large salmon released divided by effort. No angling activity reported in years with empty cells. Data for 2008 are preliminary.

River	Tracadie River					Wright River				
Year	Effort - rod days	Small salmon kept	Small salmon catch	Large salmon released	CPUE	Effort – rod days	Small salmon kept	Small salmon catch	Large salmon released	CPUE
1984										
1985										
1986	1	1	1	0	1	1	0	0	0	0
1987	4	1	1	1	0.50	1	0	0	0	0
1988										
1989										
1990	10	2	2	0	0.20					
1991	3	0	0	0	0					
1992						1	0	0	0	0
1993						1	0	0	0	0
1994										
1995										
1996										
1997										
1998						11	1	3	0	0.27
1999						3	0	0	1	0.33
2000						25	1	1	0	0.04
2001						12	0	0	0	0
2002						20	1	1	1	0.10
2003						19	0	0	0	0
2004						20	0	0	9	0.45
2005						13	0	1	5	0.46
2006						24	0	1	6	0.29
2007						21	0	4	3	0.33
2008						11	0	0	0	0

Appendix 10. Density (fish per 100 m²) (mean and one standard error) of Atlantic salmon fry and parr in Margaree River and Chéticamp River, 1957 to 2008. Standard errors are shown when more than three data points are available. No data for years with empty cells.

River	Margaree River				Cheticamp River			
Stage	Fry		Parr		Fry		Parr	
Year	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
1957	2.0		39.3					
1958	29.0	9.4	25.6					
1959	65.2	31.6	34.1					
1960	57.2	8.6	37.4					
1961	67.5	13.5	44.0					
1962	77.5							
1963	64.4		49.1					
1964	7.8	2.2	50.8					
1965	57.3	9.4	79.4					
1966	36.5	11.9	53.0					
1967	17.3	8.0	62.2					
1968	27.3	6.2	94.5					
1969	27.5	4.6	59.1					
1975	51.3	26.9	24.8	6.8				
1976	24.8	16.3	23.6	10.9				
1977	28.5	17.8	18.0	8.2				
1978	27.4	19.7	27.1	9.4				
1979	60.0	32.7	23.2	8.2				
1980								
1981	27.9		16.3					
1982	0.5		10.3					
1983	1.2		16.0					
1984	0		3.5					
1985	9.5		5.2					
1986	35.5	8.9	22.7	7.0				
1987	188.6		52.0					
1988	60.5		64.0					
1991	84.8	26.7	47.4	13.5				
1992	121.9	67.5	44.0	10.9				
1993	132.5	33.7	79.6	19.0				
1994	97.0	16.0	70.4	11.8				
1995	150.2	27.1	73.4	13.7				
1996	98.1	20.2	72.2	14.8				
1997	155.0	14.8	63.5	7.2				
1998	138.4	39.0	65.6	5.9	69.0		43.0	
1999	126.8	29.1	81.5	14.5	68.4		48.9	
2000	154.6	27.0	81.6	13.5	72.4		38.9	
2001	57.1	14.3	77.8	12.5				
2002	93.9	40.6	50.6	7.4	67.1	5.8	58.4	10.9
2003	21.6	11.2	60.6	9.6				
2004	171.6	39.5	46.5	12.8				
2005	189.8	40.6	112.4	20.2				
2006	144.8	31.2	93.7	12.5	109.3	26.4	58.1	6.4
2007	125.0	17.0	85.5	5.3	44.4		45.8	
2008	83.2	22.5	58.6	9.5	25.3	10.0	52.0	5.5

Appendix 11. Density (fish per 100 m²) (mean and one standard error) of Atlantic salmon fry and parr in River Philip, East River (Pictou), Wallace River, and West River (Antigonish), 1978 to 2008. Standard errors are shown when more than three data points are available. No data for years with empty cells.

River	River Philip				East River (Pictou)				Wallace River				West River (Antigonish)			
Stage	Fry		Parr		Fry		Parr		Fry		Parr		Fry		Parr	
Year	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
1978					94.2		32.3		61.1		14.2		48.2		38.6	
1991													226.4		67.7	150.0
1992					229.7		57.1						256.5		82.4	
1993	0		36.0		64.0		0						165.0		51.0	
1994					101.5		30.5						256.5		108.0	
1995	0		53.5		114.2		34.5						216.4		102.7	
1996									46.0		14.1		166.9	24.7	73.3	29.6
1997	48.1		60.2		220.2		38.3		85.1		11.9		381.6	85.4	106.5	42.7
1998	31.3		87.9		57.2		27.0		24.1		15.1		154.5	19.8	50.3	17.4
1999	154.1	77.3	26.0	14.3	110.1		10.9		41.0		12.5		160.0	22.0	39.4	14.3
2000	54.7	54.7	43.7	8.1	228.5		33.5		10.1		8.1		220.9	35.5	46.9	15.9
2001	173.8		39.1		64.0	14.1	65.0	18.3	48.1	28.4	34.4	17.0	65.3	31.1	85.5	14.0
2002	82.9		49.4		68.9	46.9	50.1	9.4	30.9	21.6	28.2	5.7	236.6	53.5	61.3	17.2
2003																
2004																
2005	215.0	78.1	52.3	6.9	214.0	48.6	29.1	6.1					137.1	38.8	72.8	30.7
2006	161.9		45.4						129.3		45.1					
2007	198.1	47.9	27.3	10.6									307.8		73.7	
2008	130.3		34.0										99.8		62.3	

Appendix 12. Density (mean, fish per 100 m²) of Atlantic salmon fry and parr in Barneys River, Broad Cove River and Waughs River, 2001 to 2008. No data for years with empty cells.

River	Barneys River		Broad Cove River		Waughs River	
Year	Fry	Parr	Fry	Parr	Fry	Parr
2001	49.9	81.0				
2002	196.2	32.7			209.6	15.6
2003						
2004						
2005	246.7	67.7				
2006			15.8	19.7		
2007	97.8	144.8				
2008						